This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

Congressional serial set

United States. Government Printing Office

* 5981

* 5481

Google

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETINS

Nos. 434, 437, 438

WASHINGTON
GOVERNMENT PRINTING OFFICE
1911

169315

CONTENTS

Geological Survey bulletin 434; Results of spirit leveling in Delaware, District of Columbia, Maryland, and Virginia, 1896–1909.

Same 437; Results of spirit leveling in Maine, New Hampshire, and Vermont, 1896–1909.

Same 438; Geology and mineral resources of St. Louis quadrangle, Missouri-Illinois.

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETIN 434

RESULTS OF SPIRIT LEVELING IN DELAWARE, DISTRICT OF COLUMBIA, MARYLAND, AND VIRGINIA

1896 TO 1909, INCLUSIVE

R. B. MARSHALL, CHIEF GEOGRAPHER

WORK DONE IN COOPERATION WITH THE STATE OF MARYLAND DURING THE ENTIRE PERIOD AND WITH THE STATE OF VIRGINIA IN PART OF 1908

WASHINGTON
GOVERNMENT PRINTING OFFICE
1910

CONTENTS.

Page.

Introduction 5

  Scope of the work 5

  Bench marks 6

  Cooperation and personnel 7

  Classification 7

Delaware 7

  Primary leveling 7

    Westchester and Wilmington quadrangles (Newcastle County) 7

    Dover (30′), Ellendale, Frankford, Georgetown, Harrington, Seaford, and Selbyville quadrangles (Kent, Newcastle, and Sussex counties) 9

District of Columbia 13

Maryland 15

  Barclay, Betterton, Cecilton, Chestertown, Choptank (30′), Crapo, Crisfield, Deal Island, Denton, Dover (30′), Drum Point, Harrington, Hurlock, Nanticoke, Ocean City, Oxford, Pittsville, Princess Anne, Salisbury, Seaford, Snow Hill, St. Michaels, and Tolchester (30′) quadrangles (Caroline, Cecil, Dorchester, Kent, Queen Annes, Somerset, Talbot, Wicomico, and Worcester counties) 15

  Belair, Elkton, Havre de Grace, and Parkton quadrangles (Baltimore, Cecil, and Harford counties) 21

  Annapolis, Baltimore, Ellicott, Laurel, Relay, and Westminster quadrangles (Anne Arundel, Baltimore, Carroll, and Prince Georges counties) 24

  Ijamsville, Mount Airy, Rockville, and Seneca quadrangles (Frederick, Howard, and Montgomery counties) 31

  Middletown, and Martinsburg quadrangles (Frederick and Washington counties) 35

  Emmitsburg, Hagerstown, Taneytown, and Williamsport quadrangles (Carroll, Frederick, and Washington counties) 38

  Accident, Flintstone, Frostburg, Grantsville, Hancock, Oakland, Pawpaw, and Piedmont quadrangles (Allegany, Garrett, and Washington counties) 43

Virginia 47

  Precise leveling 47

    Clarksville, Clifton Forge, Fincastle, Leslie, Lewisburg (30′), Martinsville, Natural Bridge Special, Rocky Mount (30′), and Roanoke (30′) quadrangles (Alleghany, Botetourt, Franklin, Henry, Mecklenburg, and Roanoke counties) 47

  Primary leveling 52

    Guilford and Snow Hill quadrangles (Accomac County) 52

    Hampton, Isle of Wight, Jamestown, Toano, Williamsburg, and Yorktown quadrangles (Gloucester, Isle of Wight, James City, Surrey, Warwick, and York counties) 52

Virginia—Continued.
  Primary leveling—Continued. Page.
    Appomattox (30′), Boydton, Callands, Chatham, Clarksville, Clover, Leslie, Lynchburg (30′), Moneta, Nathalie, and Virgilina quadrangles (Campbell, Charlotte, Halifax, Mecklenburg, and Pittsylvania counties) 55
    Fincastle and Natural Bridge Special quadrangles (Botetourt and Rockbridge counties) 61
    Middletown, Mount Vernon, and Seneca quadrangles (Loudoun and Fairfax counties) 62
    Pocahontas quadrangle (Tazewell County) 63
    Middlesboro quadrangle (Lee County) 64
    Abingdon quadrangle (Grayson, Russell, Smyth, and Washington counties) 65
Index 69

RESULTS OF SPIRIT LEVELING IN DELAWARE, DISTRICT OF COLUMBIA, MARYLAND, AND VIRGINIA, 1896 TO 1909, INCLUSIVE.

R. B. MARSHALL, Chief Geographer.

INTRODUCTION.

Scope of the work.—The results herein given are based on a common mean sea-level datum. The main control is the adjustment made in 1903 by the Coast and Geodetic Survey of a great net of precise levels, which combines work of various organizations and covers the eastern half of the United States.

The precise-level lines which lie wholly or partly in the combined area of Delaware, District of Columbia, Maryland, and Virginia are as follows: The Coast and Geodetic Survey lines (1) from Norfolk, Va., to Washington, D. C., and (2) the transcontinental line from Washington, D. C., westward; the Baltimore and Ohio Railroad lines (1) from Philadelphia, Pa., via Wilmington, Del., Relay, Washington Junction, and Cumberland, Md., to Grafton, W. Va., (2) from Relay via Washington to Washington Junction and on the Landenberg branch; and the United States Geological Survey lines (1) from Durham, N. C., to Clarksville, Va., and (2) from Greensboro, N. C., via Buchanan, Va., to Alleghany Station, Va.

All results of spirit leveling in these States previously published by the United States Geological Survey and all later work are included in this report, readjusted, and rearranged by quadrangles. Descriptions and elevations of bench marks are given for all 3 counties in Delaware, for 19 of the 23 counties in Maryland, and for 21 of the 100 counties in Virginia. For convenient reference the descriptions and elevations of bench marks in the District of Columbia established by the Coast and Geodetic Survey, the United States Engineer Corps, and the Baltimore and Ohio Railroad (none having been established by the United States Geological Survey) are also included in this publication, as well as the results of a double primary-level line run by the water-resources branch in the valley of the Roanoke River in Virginia from Clarksville to Rockymount.

To convert the elevations herein given to agree with the 1907 adjustment of the precise-level net, a readjustment would be necessary, correcting the elevations north and west of Washington by amounts in feet, varying gradually from place to place, approximately as follows: Washington 0.00, Relay −0.17, Baltimore −0.07, Havre de Grace +0.10, Washington Junction −0.17, Hagerstown −0.26, Cherry Run −0.28, Cumberland −0.46, and Oakland −0.46. The publication in detail of such readjustment was, however, not considered advisable, because the elevations herein given are in agreement with those given in Bulletin No. 288, containing results of spirit leveling in Pennsylvania, and Bulletin No. 399, containing results in West Virginia, all of which accord with the 1903 adjustment.

Bench marks.—The bench marks, the locations of which are given in the following lists, are mainly of three general forms: First, a circular bronze or aluminum tablet 3½ inches in diameter and one-fourth inch thick, appropriately lettered, having a 3-inch stem cemented in a drill hole, generally in the vertical wall of a public building, a bridge abutment, or other substantial masonry structure. The second form, employed where masonry or rock is not accessible, consists of a hollow wrought-iron post 3½ inches in outer diameter and 4 feet in length after being split at the bottom and expanded to 10 inches at base, so as to prevent both the easy subsidence of the post and the malicious pulling of it out of the ground. These posts are generally sunk 3 feet in the ground; the iron is heavily coated with asphalt, and over the top of the post is riveted a bronze tablet similar to that described above. The third form consists of a copper bolt 1 inch in diameter and 4 inches long, which is split at one end and expanded in a drill hole in masonry by driving on a brass wedge. But few bench marks of the third class have been used in these States, and their use has now been discontinued.

The numbers stamped on the bench marks represent the elevations to the nearest foot above mean sea level, as determined by unadjusted levels in the field. The notes have since been subjected to changes resulting from the adjustments necessary to close circuits and to those resulting from reduction to mean sea level through readjustment of the precise-level net of the United States. Some of the finally accepted elevations as printed herein therefore differ from those submitted as bench-mark numbers by 1 or 2 feet. This method of numbering bench marks has been adopted, where many level men are working in the same area at the same time, as less liable to lead to confusion in identification of bench marks than any attempt at serial numbering, and because such bench-mark number also gives an approximate statement of the elevation. It is assumed that engineers and others finding these bench marks so stamped in the field will communicate with the Director of the United States

Geological Survey in order to obtain the accepted elevation to hundredths or thousandths of a foot. Bench marks established under cooperation with the State are stamped with the state name.

Any person finding bench marks in the following lists mutilated or destroyed will confer a favor by notifying the Director, United States Geological Survey, Washington, D. C.

Cooperation and personnel.—The leveling in Maryland was done in cooperation with the State during the years 1896 to 1908, inclusive. In Virginia the only leveling done in cooperation was that in the Virgilina district in 1908. In Delaware none of the work was done in cooperation.

The field work for the years 1896 to 1906, inclusive, was done under the direction of H. M. Wilson, geographer; for the years 1907, 1908, and 1909 under Frank Sutton, geographer; and in 1908 and 1909 under the general supervision of R. B. Marshall, chief geographer.

Credit is given to the various level men directly in charge under the heading of each list.

The office work of computation, adjustment, and preparation of lists was principally done by D. H. Baldwin, topographer, under the immediate supervision of S. S. Gannett, geographer, and since 1907 under the general direction of E. M. Douglas, geographer.

Classification.—The elevations determined by the United States Geological Survey are classified, according to the accuracy of the method of leveling employed in their determination, as precise or primary. Under precise leveling are included lines run in both forward and backward directions, a high-grade instrument being used and special precautions being taken in observations and reduction to correct errors and make the lines continuously good throughout. The allowable limit of error observed by the United States Geological Survey on precise work is represented in feet by the formula $0.017\sqrt{D}$, in which D is the distance between bench marks in miles. Under primary leveling are included lines run mostly single with the Y level, precautions being taken against only the principal sources of error, and depending upon the closure of circuits for a check. The limit in feet in primary work is represented by the formula $0.05\sqrt{D}$, in which D is the length of circuit in miles.

DELAWARE.

PRIMARY LEVELING.

Westchester and Wilmington quadrangles.

NEWCASTLE COUNTY.

The elevations in the following list are based on heights of bench marks of the Philadelphia, Baltimore and Washington Railroad derived by adjustment of the railroad company's levels to agree with the elevations at Philadelphia and Havre de Grace brought by Baltimore and Ohio precise leveling corrected to accord with the 1903 adjustment elevation at Washington.

The leveling in Westchester quadrangle was done in 1900 by Hargraves Wood; in Wilmington quadrangle in 1904 by J. W. Hodges.

WESTCHESTER QUADRANGLE.

STATE LINE CORNER NO. 16, VIA GRANOGUE, CENTERVILLE, CORNER 10, AND YORK LYNN, TO CORNER 6.

	Feet.
Granogue, in front of freight station; top of rail	213.2
Centerville, 2.5 miles northwest of, 1.5 miles west of Line House, Pa., in top of state-line corner 10; bronze tablet stamped "267 HARRISBURG"	267.701
Hockessin, about 1.1 miles northwest of, 50 feet north of Avondale pike, 50 feet west of lane to Wingate's residence, in field, in top of state-line corner No. 6; aluminum tablet stamped "356 HARRISBURG 1900"	356.057

WILMINGTON QUADRANGLE.

AT WILMINGTON.

Wilmington, at Philadelphia, Baltimore and Washington Railroad station, in step of station master's room; copper bolt	10.574
Wilmington, in northwest front of post-office, 2 feet above pavement; aluminum tablet stamped "99 ADJ 1903"	99.573

NEWARK, NORTHEAST VIA CHOATE TO NEWPORT.

Newark, in doorsill of Philadelphia, Baltimore and Washington Railroad station; copper bolt	112.500
Choate, 0.2 mile east of, on top of large bowlder on south side of road near small bridge; bronze tablet stamped "43 ADJ 1903"	43.124
Stanton, in foundation wall of Stanton Hotel, west of ladies' entrance; aluminum tablet stamped "55 ADJ 1903"	54.915
Newport, 150 feet west of station, on top of small culvert on south of track; bronze tablet stamped "19 ADJ 1903"	19.476

NEWPORT, ALONG HIGHWAY SOUTHEAST TO NEWCASTLE; THENCE SOUTHWEST TO RED LION; THENCE SOUTH TO M'DONOUGH.

Newcastle, in northwest corner of post-office building, old court-house; aluminum tablet stamped "28 ADJ 1903"	27.868
State Road, 0.1 mile west of post-office, on bridge seat of small highway bridge over Thunder Gush stream, northeast abutment; aluminum tablet stamped "17 ADJ 1903"	17.585
Red Lion, 0.6 mile south of, on southeast abutment of small bridge near fork of road leading east; aluminum tablet stamped "19 ADJ 1903"	19.398
St. Georges, on top of retaining wall which was old canal lock; bronze tablet stamped "11 ADJ 1903"	11.465
McDonough, 0.5 mile north of, at Boyds Corners, northwest corner of crossroads; corner of yard and garden; iron post stamped "ADJ 60 1903"	60.686

NEWARK, ALONG HIGHWAY SOUTH TO MOUNT PLEASANT; THENCE EAST TO M'DONOUGH.

Couches Bridge, on top of retaining wall on end near southeast side; bronze tablet stamped "50 ADJ 1903"	50.188
Glasgow, in doorsill of Pencador Church, main entrance; bronze tablet stamped "69 ADJ 1903"	68.982

	Feet.
Summit Bridge, post-office, at northeast corner of Buck Hotel; iron post stamped "72 ADJ 1903"	71.860
Mount Pleasant, in doorsill of south station office door; aluminum tablet stamped "70 ADJ 1903"	70.710

Dover (30′), Ellendale, Frankford, Georgetown, Harrington, Seaford, and Selbyville quadrangles.

KENT, NEWCASTLE, AND SUSSEX COUNTIES.

The elevations in the following list are based on tide-gage records made by the Coast and Geodetic Survey at several points in Chesapeake Bay and at Franklin City, Chincoteague Bay, carried through adjoining primary-level work on "Eastern Shore," Maryland, and levels of the Philadelphia, Baltimore and Washington Railroad.

The leveling in Dover quadrangle was done in 1896 by O. L. Pettibone and Charles Goldsborough, and the remainder was done as follows: In 1900, in Harrington and Seaford quadrangles, by T. D. Leonard, and in Seaford quadrangle by C. H. Semper. The leveling in Georgetown and Ellendale quadrangles and additional work in the Frankford, Harrington, Seaford, and Selbyville quadrangles was done in 1908 by H. M. Gillman, jr.

DOVER (30′) QUADRANGLE.

BOHEMIA MILLS EAST, VIA MIDDLETOWN, TO ODESSA; THENCE SOUTHEAST TO TAYLORS BRIDGE ROAD; THENCE WEST TO TOWNSEND; THENCE SOUTHWEST TO MASSEY.

	Feet.
Middletown, near station, west side of front corner of National Hotel; bronze tablet stamped "65"	65.684
Middletown; copper bolt in doorstep of ladies' waiting room of railroad station, stamped "17" (Pennsylvania Railroad bench mark)	64.92
Odessa, 1.25 miles south of, at fork of road, in foundation of schoolhouse; bronze tablet stamped "37"	38.106
Townsend, 3 miles east of, in northwest corner of foundation of shed of John Corbett's small house; bronze tablet stamped "60"	60.504
Townsend; copper bolt at southwest corner of hotel, 8 inches from corner of curb, stamped "U.S.G.S.-64-B. M."	64.485

MASSEY, EAST VIA CLAYTON, TO RAYMONDS NECK.

Clayton, on north side of Hotel Stoeckle; bronze tablet stamped "45"	45.286
Whitehall crossroads, Raymonds Neck, in northeast corner of crossroads; iron post stamped "19"	20.066

MARYDEL, NORTHEAST ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO CLAYTON.

Hartly, in southwest corner of foundation of Joseph Poor's hotel; bronze tablet stamped "74"	74.176
Hazels Corners, in northeast corner of schoolhouse; bronze tablet stamped "70"	70.698
Downs Chapel, 0.5 mile west of, east of road, at corner of fence; top of boundary stone	64.33

CLAYTON, SOUTH TO HARRINGTON.[a]

	Feet.
Cheswold, in doorsill of ladies' waiting room at station; copper bolt (railroad bench mark)	44.870
Cheswold, 250 feet southwest of passenger station, corner of crossroads, in corner of stone; bronze tablet stamped "43"	43.717
Dover, at Philadelphia, Baltimore and Washington Railroad station, in doorsill of ladies' waiting room; copper bolt (railroad bench mark)	31.490
Dover, in south side of post-office; bronze tablet stamped "34"	34.380
Wyoming, at railroad station, in doorsill of ladies' waiting room; copper bolt (railroad bench mark)	42.800
Wyoming, 200 feet southwest of station, in east end of frame factory; bronze tablet stamped "42"	42.873
Woodside, at station; top of railroad monument (railroad bench mark)	59.316
Woodside, at south end of freight house; iron post stamped "60"	60.296

HARRINGTON QUADRANGLE.

WHITELEYSBURG, EAST TO HARRINGTON; THENCE SOUTH ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD TO GREENWOOD.

Harrington, at station, in doorsill of waiting room; copper bolt (railroad bench mark; railroad elevation, 61.53)	62.17
Harrington, in small doorsill of station; aluminum tablet stamped "BALTO 62"	61.88
Greenwood, diagonally across track from station, at southeast corner of piazza of F. E. Owens's store; iron post stamped "BALTO 47"	47.907

GREENWOOD, EAST ALONG MARYLAND, DELAWARE AND VIRGINIA RAILWAY, TO OAKLEY.

Owens station, northwest of railroad road crossing, in east face of brick foundation to porch of frame dwelling owned by C. P. Tatman; aluminum tablet stamped "1908, 56"	55.916
Oakley station, east of wagon road, 200 feet south of track, in north face of northwest corner of foundation to house owned by C. W. Short; aluminum tablet stamped "1908, 55"	54.309

ELLENDALE QUADRANGLE.

OAKLEY, EAST ALONG MARYLAND, DELAWARE AND VIRGINIA RAILWAY, TO ELLENDALE; THENCE SOUTH ALONG PHILADELPHIA BALTIMORE AND WASHINGTON RAILROAD TO ROBBINS.

Ellendale, 100 feet northwest of intersection of Maryland, Delaware and Virginia Railway and Delaware, Maryland and Virginia Railroad, in center of west face of foundation to dwelling owned by D. A. Reed; aluminum tablet stamped "1908, 52"	51.996
Ellendale, 1 mile south of, 50 feet west of tracks, 300 feet north of property post, in tree stump; nail	51.13
Robbins, 5 feet from southwest corner of railway road crossing at station; in top of stone monument; copper bolt (Pennsylvania Railroad bench mark 5)	47.161

SEAFORD QUADRANGLE.

GREENWOOD, SOUTH ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO SEAFORD; THENCE WEST TO OAKGROVE.

Ross, in front of station; top of rail	37.2
Seaford, at corner of High and Cornwell streets, in stone doorsill of Sussex National Bank; aluminum tablet stamped "BALTO 29"	29.501

---

[a] Bench marks set from Philadelphia, Baltimore and Washington Railroad levels; corrected by adding 0.64 foot.

	Feet.
Seaford, in stone doorsill of ladies' waiting room at station; top of bolt (Pennsylvania Railroad bench mark)	11.43
Oakgrove, 0.3 mile west of, north of Philadelphia, Baltimore and Washington Railroad tracks; stone post marking Maryland-Delaware state line; top marked "47"	47.75

SEAFORD, SOUTH ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO DELMAR.

Broadcreek, 500 feet east of railroad, 300 feet south of crossroads on main road, in foundation of northeast corner of James Hall's house; aluminum tablet stamped "BALTO 41"	41.842
Laurel, at station, in doorsill of ladies' waiting room; copper bolt (Pennsylvania Railroad bench mark 58)	30.487

SEAFORD, EAST ALONG HIGHWAY, TO POINT 3.1 MILES EAST OF CONCORD.

Blades, at southeast corner of road forks, in root of tree; nail	13.20
Seaford, 1.6 miles east of, at southwest corner of T road south, in root of pine tree; nail	8.65
Concord, at fence corner of Frank Jefferson's property at road south, on stone; chisel mark	28.13
Concord, east of road forks, in root of cedar; nail	30.53
Concord, 1.3 miles east of, 140 feet north of road, in east face of southeast corner of brick pillar under house owned by W. M. Smith; aluminum tablet stamped "1908, 34"	33.317
Concord, 2.2 miles east of, at southeast corner of crossroads, in west face of cedar tree; spike	35.91
Knowles crossroads, 2.8 miles west of, 100 feet west of crossroads, west of road, in south side of persimmon tree; nail	34.94

LAUREL, EAST ALONG HIGHWAY, TO PEPPER.

Laurel, station, in doorsill of ladies' waiting room; copper bolt (Pennsylvania Railroad bench mark 58)	30.487
Laurel, east edge of, south of road, 240 feet east of road forks, on top of white marble monument marking city limits; center of letter "C"	26.38
Pepper, 2.3 miles west of, north of road, in center of brick pier under south side of frame dwelling of William De Shield's estate; aluminum tablet stamped "1908, 34"	33.640

GEORGETOWN QUADRANGLE.

ROBBINS, SOUTHEAST ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO DAGSBORO.

Georgetown, south of track, 5 feet from northwest corner in west face of brick station of Pennsylvania Railroad; aluminum tablet stamped "1908, 57"	56.121
Stockley, 0.8 mile northwest of, 600 feet west of railroad, in east face of foundation under bay window to left of main window of house owned by Mrs. B. A. Johnstone; aluminum tablet stamped "1908, 47"	46.430
Stockley, 2 miles southeast of, 1,020 feet west of milepost "48–6," on main road to Millsboro, in west face of brick pillar under southwest corner of house owned by Cyrus Baker; aluminum tablet stamped "1908, 34"	33.529
Millsboro, south of Main street, 100 feet east of tracks, in north face of northwest corner of Millsboro Trust and Savings Deposit Company's building; aluminum tablet stamped "1908, 27"	26.463
Dagsboro, 1,160 feet east of station, in west face of southwest corner of First National Bank; aluminum tablet stamped "1908, 29"	28.243

GEORGETOWN, SOUTHWEST ALONG HIGHWAY, TO POINT 3.1 MILES EAST OF CONCORD.

	Feet.
Georgetown, 1 mile southwest of, 250 feet southwest of crossroads, north of road, in root on north side of tree; nail	48.70
Georgetown, 1.3 miles southwest of, at southwest corner of T road south, in root of apple tree; nail	51.34
Georgetown, 2.5 miles southwest of, at northeast corner of crossroads, in root of oak tree; nail	50.29
Georgetown, 3.2 miles southwest of, north of road, at private road south, in south face of brick foundation of house owned by William P. Pepper; aluminum tablet stamped "1908, 50"	49.880
Knowles, on stone at northwest corner of crossroads; chisel mark	47.24
Knowles, west of crossroads, north of road, 400 feet west of private road south, in south face of brick foundation of house owned by D. H. Hill; aluminum tablet stamped "1908, 47"	46.278
Knowles, 1.1 miles west of, in center of road forks and crossroads, in root of gum tree; nail	44.20

MILLSBORO, SOUTHWEST ALONG HIGHWAY, TO LOWES CROSSROADS; THENCE WEST TO PEPPER.

Millsboro, 0.4 mile southwest of, at road forks, in root at south side of oak tree; nail	26.14
Millsboro, 2.3 miles southwest of, at northeast corner of crossroads, on stone post; chisel mark	41.11
Mission, 2 miles east of, at southwest corner of T road west, in east face of brick foundation of porch of house owned by Viola Sirman; aluminum tablet stamped "1908, 38"	38.214
Mission, 1.4 miles east of, at west corner of crossroads, in root of apple tree; nail	41.68
Mission, at northeast corner of crossroads, in root of oak tree; nail	45.31
Mission, 0.7 mile northwest of, southeast of road, 1,540 feet southeast of road forks, in north face of northwest corner of brick pier at northwest corner of house owned by M. H. Mitchell; aluminum tablet stamped "1908, 48"	47.490
Lowes, at northeast corner of crossroads, in root of tree; nail	50.62
Lowes, north of road, 370 feet west of crossroads, in east face of foundation to porch of house owned by W. A. Cannon; aluminum tablet stamped "1908, 51"	50.571
Lowes, 1 mile northwest of crossroads, at road forks, in stump of pine tree; nail	51.21
Lowes, 1.9 miles west of crossroads, south of road, third tree to west, in root of large oak tree in front of W. J. West's house; nail	53.43
Lowes, 2.7 miles west of, at northwest corner of crossroads, in root of tree; nail	46.88
Pepper, 1.4 miles east of, north of road, 1,600 feet west of crossroads, in east face of brick foundation to barn owned by T. S. Lescates; aluminum tablet stamped "1908, 44"	43.642
Pepper, 0.4 mile east of, at northwest corner of crossroads, 50 feet south of house, in root of maple tree; nail	40.64
Pepper, at northeast corner of crossroads, in root of large sycamore tree; nail	39.88

FRANKFORD QUADRANGLE.

DAGSBORO, SOUTHEAST ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO CROSSING 1 MILE SOUTH OF FRANKFORD.

Dagsboro, 0.8 mile south of, on west end of iron drain pipe; painted square	29.09
Frankford, 250 feet northeast of station, in south face of southwest corner of First National Bank; aluminum tablet stamped "1908, 37"	36.728

SELBYVILLE QUADRANGLE.

POINT 1 MILE SOUTH OF FRANKFORD, SOUTH ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD, TO SELBYVILLE; THENCE WEST TO TIE ON OLD LINE.

	Feet.
Selbyville, in northwest face of buttress to left of entrance of First National Bank; aluminum tablet stamped "1908, 38"	37.205
Selbyville, 2.2 miles west of, in front of J. F. Baker's house, south of road, in root of black-walnut tree; nail	42.014

DISTRICT OF COLUMBIA.[a]

MAIN LINE, BALTIMORE AND OHIO RAILROAD.

	Feet.
Milepost "W. 2-Baltimore 38," cross on top of vertical rail section set opposite (bench mark 1)	41.995
Trinidad yards, southwest end of, in northwest end of northeast abutment of culvert, about 50 feet southwest of telegraph pole 37/13; copper bolt (bench mark 2)	58.294
Winthrop Heights, 0.2 mile southwest of, in northeast end of southeast coping of arch culvert opposite telegraph pole 36/16; copper bolt (bench mark 3)	67.787
Langdon, 150 feet southwest of station, in southwest end of northwest coping of culvert; copper bolt (bench mark 4)	68.431

METROPOLITAN BRANCH, BALTIMORE AND OHIO RAILROAD.

Milepost "Washington 1 mile," on top of section rail set vertically in ground between tracks; cross (bench mark 2)	41.247
Eckington, between the tracks opposite milepost "Washington 2 miles," on top of section rail set vertically in ground between tracks; cross (bench mark 3)	95.484
Brookland, between tracks at south end of bridge 2A, in bridge seat, under grade crossing of the electric car line; copper bolt (bench mark 3A)	107.448
Brookland, between tracks at north end of bridge culvert 3A, in bridge seat; copper bolt (bench mark 4)	129.153
Brookland, about 1 mile northwest of, about 3.8 miles from Washington, west of tracks, south of box culvert, opposite telegraph pole 3/25; copper bolt (bench mark 5)	160.668
Stotts, on the south abutment of bridge 5B, in west end of bridge seat; copper bolt (bench mark 6)	204.652
Takoma Park, between tracks on the east abutment of bridge 7A, in bridge seat; copper bolt (bench mark 7)	266.925

VARIOUS LOCALITIES.

Navy-Yard, southwest corner of commandant's office, brick column under southwest corner of porch; upper surface of iron plate	9.440
Capitol, in granite water table under the first window west of the southeast corner of the Senate wing, in the middle of a bronze plate 5 inches square, placed vertically and inscribed "Capitol Bench Mark, U. S. Coast and Geodetic Survey, 1884;" top of bronze bolt	90.685
Washington Monument, in a stone on the southwest corner of the top layer of foundation; top of a brass bolt placed vertically, marked "O" (bench mark established and used by the U. S. Engineer Corps in the erection of the monument; the aluminum point of the pyramidion is said to be 555 feet 4½ inches above this bolt)	40.435

---

[a] Bench marks established by the Baltimore and Ohio Railroad, the Coast and Geodetic Survey, and the U. S. Engineer Corps.

	Feet.
National Museum, north side of main building, on the granite sill of the outer door of main entrance, 5 feet from east side of door, 5 feet from west side of door, 10½ inches from the north edge of sill, about 10 feet from the inner door leading to the Museum; center of cross (bench mark 82)	29.721
Washington No. XI (Georgetown), in northwest coping of north abutment of Aqueduct Bridge over Potomac River; bottom of square inclosing a St. Andrews cross	31.648
Hill, at trigonometrical station, near Washington	275.822
Navy-Yard Bridge, at east end of north side of northeast corner; curbstone (bench mark II)	7.652
Navy-Yard, on stone around flagstaff near entrance gate; cross (bench mark I or 5)	39.111
Coast Survey office, new building on New Jersey avenue near B street SE., in vestibule of main entrance; center of central square	77.908
Navy-Yard, in top of one of the coping stones of wharf or dock on the east side of the boathouse slip, 28¾ feet south of boathouse, 10 inches from outer edge of stone; center of rude cross and circle (bench mark 8 or E)	5.349
Navy-Yard, at main entrance to ordnance office, in north end of granite doorstep (about 8 feet long by 14 inches wide by 8 inches thick) set on 3 feet of concrete; bottom of square hole about 0.15 or 0.0125 foot deep, marked "U.S.C.&□G.S.B.M." (bench mark 14)	16.398
Capital Traction Company's building, corner Eighth and M streets SE., at entrance on Eighth street, near southeast corner of foundation; bench mark 16 or 24	47.517
Bruen Mission Church, corner M and Half streets SE., in middle of stone doorsill of M street entrance; center of rude cross (bench mark 22)	31.479
M Street Bridge, at First street SW., in stone abutment on southwest corner, center of rude circle (bench mark 25)	11.821
Faith Chapel, on M street, between Four-and-a-half and Sixth streets SW., in southwest corner of top surface of stone doorsill; rude cross (bench mark 30)	24.526
Arsenal grounds (old), on stone foundation of the west post of the central or carriage gate; northwest corner of iron plate (bench mark 36)	20.244
Seventh-street power house, P street SW., on upper surface of corner of foundation stone on west side of western entrance; rude cross (bench mark 41)	17.872
Brewery, corner Delaware avenue and E street SW.; north corner of northern window sill (bench mark 47)	13.608
St. Paul's African Methodist Episcopal Church, Eighth street SW., in south corner of south doorsill; rude cross (bench mark 79)	32.291
Kendall Green Baptist Church, on Ninth street, between B and C streets SW., in south end of top stone of south doorstep; rude cross (bench mark 80)	32.778
Smithsonian Institution, in stone coping of area wall in front of basement window at northeast corner; cross (bench mark 84)	31.484
Washington Monument grounds, near Bureau of Engraving and Printing, 25 feet east of board walk at southeast corner of grounds, 150 feet from fence, about 20 feet northeast of a large elm tree (near bridle path), about 120 feet from intersection of bridle path and roadway, about 3 feet below the surface of the ground; brass plus set in a stone which rests on concrete with an iron tube covered by a rough flat stone on the surface (U. S. Engineer Corps bench mark 88)	29.435
Washington Monument, about 34 meters south of, a few feet outside of the driveway; top surface of an underground obelisk covered with an iron plate (U. S. Engineer Corps bench mark 92)	36.910

	Feet.
Washington Monument, at southwest corner of, about 2 inches below the surface of granolithic pavement; top surface of an iron plate (bench mark 93)	40. 565
Washington Monument, at southwest corner of, just outside granolithic pavement; top of brass cap over iron rod (bench mark 95)	39. 572
Washington Monument, at southeast corner of, just outside granolithic pavement; top of brass cap over iron rod (bench mark 96)	39. 382
Washington Monument, at northeast corner of, just outside granolithic pavement; top of brass cap over iron rod (bench mark 97)	39. 501
Washington Monument, at northwest corner of, just outside granolithic pavement; top of brass cap over iron rod (bench mark 98)	39. 533
Heurich Brewery, on C street, between Twenty-fifth and Twenty-sixth streets NW., outer right-hand (east) corner of sill of office door (bench mark 101)	22. 149
Washington Gas Company's office, on the northwest corner of Twenty-sixth and G streets NW.; outer west corner of the doorsill of south entrance (bench mark 102)	33. 151
Easby Point, Engineer's wharf, about 2 feet north of, rude cross cut in sea wall (bench mark 103)	4. 549

MARYLAND.

Barclay, Betterton, Cecilton, Chestertown, Choptank (30′), Crapo, Crisfield, Deal Island, Denton, Dover (30′), Drum Point, Harrington, Hurlock, Nanticoke, Ocean City, Oxford, Pittsville, Princess Anne, Salisbury, Seaford, Snow Hill, St. Michaels, and Tolchester (30′) quadrangles.

CAROLINE, CECIL, DORCHESTER, KENT, QUEEN ANNES, SOMERSET, TALBOT, WICOMICO, AND WORCESTER COUNTIES.

The elevations in the following list are based on heights derived by various gages of the Coast and Geodetic Survey and on checked levels of the Pennsylvania Railroad plus 0.64 foot, a mean correction derived through United States Geological Survey connections. For additional elevations in Dover, Harrington, and Seaford quadrangles see Delaware list (pp. 9, 10); and for Franklin City, Va., in Snow Hill quadrangle, see Virginia list (p. 52).

The leveling was done as follows: Cecilton and Barclay quadrangles, in 1896 by Charles Goldsborough and O. L. Pettibone; Barclay quadrangle, additional work in 1899 by T. D. Leonard and in 1904 by Ralph Hutchins; Betterton, Chestertown, and St. Michaels quadrangles, in 1899 by T. D. Leonard; Hurlock quadrangle, in 1899 by T. D. Leonard, in 1900 by George Bailey, and in 1904 by C. A. Clunet; Seaford quadrangle, in 1899 by T. D. Leonard and in 1904 by C. A. Clunet; Denton and Harrington quadrangles, in 1899 by T. D. Leonard and in 1904 by B. J. Green; Oxford quadrangle, in 1900 by George Bailey and J. W. Hodges, in 1902 by W. C. Palmer, and in 1904 by C. A. Clunet; Crapo quadrangle, in 1900 by J. W. Hodges and in 1904 by C. A. Clunet; Drum Point quadrangle, in 1904 by C. A. Clunet; Nanticoke quadrangle, in 1900 by J. W. Hodges and in 1902 by W. C. Palmer; Salisbury, Princess Anne, and Pittsville quadrangles, in 1900 by J. W. Hodges and C. H. Semper; Crisfield and Deal Island quadrangles, in 1900 by C. H. Semper; Snow Hill and Ocean quadrangles, in 1900 by J. W. Hodges.

CECILTON (DOVER 30′) QUADRANGLE.

CHESAPEAKE CITY, SOUTHWEST VIA CAYOTS CORNERS TO EARLEVILLE; THENCE SOUTH AND WEST TO LOCUST GROVE.

	Feet.
Cayots Corners, at road forks; iron post stamped "83"	83.612
Earleville, in stone in front of S. Duhamel's store; bronze tablet stamped "85"	85.282
Fredericktown, in face of northwest wing wall of bridge over Sassafras River; bronze tablet stamped "5"	5.460
Locust Grove, 40 feet north of crossroads and east side of Beaston's house; iron post stamped "76"	77.075

LOCUST GROVE, SOUTH TO CHESTERVILLE.

Blacks station, on stone foundation of middle pillar of porch in front of store; highest point	70.26
Chesterville, north corner of crossroads, at corner of brick storehouse; iron post stamped "55"	55.829

MILLINGTON, NORTH ALONG PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD AND HIGHWAYS, TO BOHEMIA MILLS.

Millington, northwest corner of Cypress and Sassafras streets; copper plug in doorsill of store, stamped "26"	27.120
Massey, southeast corner of foundation of Walsberger's store, northwest corner of crossroads; bronze tablet stamped "65"	65.770
Massey, 3.5 miles east of, at Maryland-Delaware state line; top of boundary stone	68.10
Sassafras, dwelling of Mr. Earnest; copper plug in step to back porch, stamped "U.S.G.S. 34 ft. B. M."	34.791

BARCLAY (DOVER 30′) QUADRANGLE.

CHESTERVILLE, SOUTH TO BENSON CENTER; THENCE EAST TO SUDLERSVILLE; THENCE NORTH TO MILLINGTON.

Benton Corners, 1,000 feet west of, in northeast corner of foundation stone of farmhouse; bronze tablet stamped "60"	60.911
Barclay, 1.5 miles north of, 50 feet west of railroad crossing, southwest corner of road; top of large stone	69.85
Sudlersville, corner of Church and Main streets, northeast corner of stone foundation; bronze tablet stamped "66"	66.798

BARCLAY, SOUTHWEST TO ROBERTS; THENCE SOUTHEAST TO GOLDSBORO; THENCE NORTHEAST TO MARYDEL.

Roberts, at southeast corner of Scott's store; iron post stamped "78"	78.469
Ingleside, southwest corner of Beatty's yard; iron post stamped "62"	62.410
Hollingsworth, south corner of crossroads, outside of corner of garden fence; iron post stamped "66"	66.954
Goldsboro, on east corner of railroad station; bronze tablet stamped "63"	63.548
Marydel, south end of freight house; bronze tablet stamped "63"	63.51

CRUMPTON, SOUTHWEST TO M'GINNES.

McGinnes, 2.9 miles southwest of Crumpton, southeast corner of crossroads, 50 feet east of store, in northwest corner of Williams's yard; iron post stamped "72, 1904"	72.381

SUDLERSVILLE, EAST 4 MILES.

	Feet.
Peters Corners, 3.8 miles east of Sudlersville, northwest corner of crossroads, in base of chimney of private house; aluminum tablet stamped "66, 1904"	66. 108

BETTERTON (TOLCHESTER 30′) QUADRANGLE.

LOCUST GROVE, WEST TO STILLPOND; THENCE SOUTHWEST TO FAIRLEE.

Stillpond, at east side of F. H. Harper's store; iron post stamped "BALTO 79"	78. 813
Hanesville, in front of post-office at road to west; iron post stamped "62 BALTO"	62. 167

CHESTERTOWN (TOLCHESTER 30′) QUADRANGLE.

FAIRLEE, SOUTHEAST VIA CHESTERTOWN AND STARKLEY CORNER, TO ROBERTS.

Fairlee, 60 feet east of S. D. Seaverton's boot and shoe shop, in large rock; aluminum tablet stamped "78 BALTO"	78. 543
Chestertown court-house; aluminum tablet stamped "22 BALTO"	21. 918
Starkley Corner, at northeast corner of crossroads; iron post stamped "54 BALTO"	54. 794

FAIRLEE, SOUTH TO EDESVILLE; THENCE SOUTHEAST TO CENTERVILLE; THENCE EAST TO ROBERTS.

Edesville, just south of entrance to store of W. L. Sutton; iron post stamped "24 BALTO"	24. 805
Hadaway's store, northeast of entrance, just under window; iron post stamped "18 BALTO"	18. 738
Centerville, in southeast corner of court-house yard across path from state survey meridian monument; iron post stamped "60 BALTO"	60. 70

ST. MICHAELS (CHOPTANK 30′) QUADRANGLE.

CENTERVILLE, SOUTH TO EASTON; THENCE EAST TO TANYARD.

Wye Mills, corner of Anthony's store, at the end of piazza; iron post stamped "21 BALTO"	22. 121
Longwoods, at southeast corner of Callahan's store; iron post stamped "50 BALTO"	51. 249
Easton, at south end of second step of court-house; aluminum tablet stamped "37 BALTO"	37. 545

OXFORD (CHOPTANK 30′) QUADRANGLE.

EASTON, SOUTH TO TRAPPE.

Trappe, corner Easton road and West street, southeast corner of store of Clarck & Kirby, in foundation stone; aluminum tablet stamped "55"	54. 746

AIREYS, NORTHWEST TO CAMBRIDGE; THENCE SOUTHEAST TO BUCKTOWN.

Cambridge, in southwest corner of court-house, about 1 foot above ground; bronze tablet stamped "19 BALTO"	20. 160

SMITHVILLE, NORTHEAST TO MILTON; THENCE SOUTHEAST TO LITTLE BLACKWATER RIVER

Milton (Woolford post-office), north of road opposite road fork to Gum Swamp, in front yard of Baptist Church; iron post stamped "6 ADJ"	5. 622

DENTON QUADRANGLE.

GOLDSBORO, SOUTHWEST ALONG PENNSYLVANIA RAILROAD TO QUEEN ANNE; THENCE SOUTH ALONG HIGHWAY TO GRIFFIN; THENCE EAST TO HOBBS.

	Feet.
Greensboro, 10 feet north of station, at edge of platform; iron post stamped "40 BALTO"	40.817
Ridgely, in lawn at northeast corner of Pennsylvania Railroad station, 4 feet from platform; iron post stamped "69 ADJ 1903"	69.070
Hillsboro, at northeast corner of H. Williams's dwelling, on north foundation wall; aluminum tablet stamped "47 ADJ 1903"	46.599
Griffin, at northeast corner of yard to W. H. Robinson's dwelling; iron post stamped "42 ADJ 1903"	41.376
Denton, in court-house yard, on top of south meridian post; bronze tablet	37.916
Denton, on southeast corner of court-house; aluminum tablet stamped "43 ADJ 1903"	42.703

HOBBS, SOUTHWEST ALONG HIGHWAY, TO TANYARD.

Williston, 30 feet east of southeast corner of store; iron post stamped "24 ADJ 1903"	24.209

TANYARD, EAST ALONG HIGHWAYS TO AMERICAN CORNERS; THENCE NORTH TO HOBBS.

Tanyard, 1.5 miles west of, west end of Dover Bridge, at west end of C. H. Sinclair's house, north of road; iron post stamped "4 BALTO"	4.789
Newton, 50 feet east of store, at corner of crossroads; iron post stamped "40 ADJ 1903"	39.678
Fowling Creek, in yard to W. H. Collins's dwelling, 50 feet west of M. E. Church; iron post stamped "48 ADJ 1903"	48.567
American Corners, at crossroads, in corner of field in front of store; iron post stamped "55 ADJ 1903"	55.107
Concord, 10 feet north of store, at southeast corner of yard to C. E. Todd's dwelling; iron post stamped "55 ADJ 1903"	55.723
Hobbs, in southwest corner of yard to H. C. Hobbs's dwelling, 50 feet northeast of Hobbs station; iron post stamped "55 ADJ 1903"	54.914

HARRINGTON QUADRANGLE.

HOBBS, NORTH ALONG HIGHWAYS VIA BURRSVILLE AND WHITELEYSBURG TO GREENSBORO.

Burrsville, 500 feet north of forks of road east, west of street in front of William Outtens's blacksmith shop; iron post stamped "58 ADJ 1903"	58.545
Whiteleysburg, at northeast corner of Anthony's store; iron post stamped "63 BALTO"	63.175

HURLOCK QUADRANGLE.

TANYARD, SOUTHEAST TO FEDERALSBURG; THENCE SOUTHWEST TO WILLIAMSBURG; THENCE SOUTH TO RHODESVILLE; THENCE SOUTHWEST TO LINKWOOD.

Linchester, at west side of J. F. Tegar's store; iron post stamped "18 BALTO"	18.783
Federalsburg, at T. O. Jefferson's store; iron post stamped "10 BALTO".	10.621
Linkwood, in grass plat at intersection of roads at station; iron post stamped "21 BALTO"	22.234

RHODESDALE, SOUTHEAST TO BROOKVIEW; THENCE NORTH TO ELDORADO; THENCE EAST TO GALESTOWN.

Rhodesdale, at northwest corner of post-office; iron post stamped "ADJ 40"	40.619
Brookview, at southeast corner of W. D. Murphy's store, 300 feet west of Marshyhope Creek; iron post stamped "ADJ 24"	24.105

SEAFORD QUADRANGLE.

GALESTOWN, NORTH VIA OAK GROVE TO FEDERALSBURG.

	Feet.
Reliance, 1 mile south of, on top of Delaware-Maryland state line monument; cross mark	43.138
Reliance, at northeast corner of crossroads, at southwest corner of Mrs. Phillips's house, opposite former post-office; iron post stamped "45 ADJ"	45.064
Oak Grove, 0.25 mile west of, on top of Delaware-Maryland state line monument, 10 feet north of railroad; cross mark	47.75
Oak Grove, in front of station; top of rail	46.4

CRAPO QUADRANGLE.

BUCKTOWN, SOUTHEAST TO BESTPITCH.

Bucktown, in brick foundation at southwest corner of former post-office; iron post stamped "4 BALTO"	5.310

BUCKTOWN, SOUTHWEST TO GOLDEN HILL.

Bucktown, 4.5 miles west of, at southeast corner of road forks, 7 feet south of letter-box post of W. T. Elzy; iron post stamped "ADJ 7"	6.739
Gum Swamp, north of road, at wood-road fork north, opposite church and schoolhouse; iron post stamped "ADJ 3"	3.321
Golden Hill, at road fork at Louis Keene's store; iron post stamped "ADJ 3"	2.812

GOLDEN HILL, SOUTHEAST TO WINGATE.

Lakesville, 0.5 mile north of, 150 feet south of Nazareth M. E. Church, in northeast corner of schoolhouse foundation; bronze tablet stamped "3 ADJ"	2.589
Wingate, at junction of roads 100 yards north of post-office, at southeast corner of road, just outside of fence in front of Mr. Wingate's house; iron post stamped "3 ADJ"	2.828

DRUM POINT QUADRANGLE.

GOLDEN HILL, NORTHWEST TO SMITHVILLE.

Smithville, east of road in front of schoolhouse; iron post stamped "6 ADJ"	5.886

NANTICOKE QUADRANGLE.

BESTPITCH, EAST VIA DRAWBRIDGE TO QUANTICO.

Drawbridge, in brick foundation on south side of small store; bronze tablet stamped "3 BALTO"	4.130

RHODESDALE, SOUTH TO VIENNA; THENCE SOUTHEAST VIA MARDELA SPRINGS TO QUANTICO.

Vienna, in northwest face near north corner of brick house owned in 1902 by S. G. LeCompte, 60 feet southwest of road, 180 feet northwest of Nanticoke River, in foundation; bronze tablet stamped "14"	14.288
Mardela Springs, 15 feet east of post-office building, 30 feet south of road, in grounds of J. L. Langsdale; iron post stamped "27"	26.685

QUANTICO, SOUTH-SOUTHWEST TO WHITEHAVEN; THENCE EAST TO LORETTO.

Whitehaven, southwest side of house owned in 1902 by William Dolby, in brick foundation; bronze tablet stamped "5"	4.576

SALISBURY QUADRANGLE.

DELMAR, SOUTH ALONG NEW YORK, PHILADELPHIA AND NORFOLK RAILROAD TO LORETTO.

	Feet.
Salisbury, in southwest corner of front face of court-house; aluminum tablet stamped "22 BALTO"	23.200
Eden, in northwest corner of foundation of post-office; aluminum tablet stamped "29 BALTO"	29.968

EDEN, EAST TO LONGRIDGE.

Longridge, at southeast corner of former post-office; iron post stamped "50 BALTO"	50.727

QUANTICO, EAST TO SALISBURY.

Quantico, in corner of fence at Episcopal Church north of Quantico street; iron post stamped "19 BALTO"	20.227

PRINCESS ANNE QUADRANGLE.

LORETTO, SOUTH ALONG NEW YORK, PHILADELPHIA AND NORFOLK RAILROAD TO KINGSTON.

Princess Anne, in front face of Somerset Savings Bank on Main street; bronze tablet stamped "17 BALTO"	18.130
Westover, at intersection of New York, Philadelphia and Norfolk Railroad and road leading to Cottage Grove, opposite M. E. Miles's store; iron post stamped "15 BALTO"	14.156

LONGRIDGE, SOUTH TO POCOMOKE CITY.

Whiteburg, at southeast corner of old store, inside of J. S. P. White's yard, in front of house; iron post stamped "30 BALTO"	29.674

WESTOVER, EAST VIA POCOMOKE CITY TO GOODWILL.

Pocomoke City, in doorsill of Pocomoke City Hotel, corner Front and Market streets; aluminum tablet stamped "8 BALTO"	7.523

DEAL ISLAND QUADRANGLE.

KINGSTON, SOUTHWEST TO HOPEWELL.

Marion, at southeast corner of A. Davis's drug store on Main street, 60 feet east of railroad and 25 feet north of station; iron post stamped "7 BALTO"	7.417

CRISFIELD QUADRANGLE.

AT CRISFIELD.

Crisfield, J. W. Dishatoon's grocery store, face of doorsill; aluminum tablet stamped "5 BALTO 1900" (elevation determined from Coast and Geodetic Survey tide gage)	4.920

SNOW HILL QUADRANGLE.

FRANKLIN CITY, NORTHWEST TO GOODWILL; THENCE NORTHEAST TO SNOW HILL; THENCE NORTHWEST VIA COLDBOURNE TO LONGRIDGE.

Franklin City, 1 mile north of, on southeast corner of Virginia-Maryland boundary stone, on outskirts of Greenbackville; marked "7"	6.72
Klej Grange, at intersection of roads from Mattaponi Landing and Snow Hill, on property of Drexel heirs, opposite former post-office; iron post stamped "30 BALTO"	29.283

	Feet.
Snow Hill, in sill of front entrance porch of court-house, on northeast side of steps; tablet stamped "21 BALTO"	20.552
Colbourne, opposite former post-office, in northwest corner of Mr. J. E. Dickerson's front yard; iron post stamped "40 BALTO"	40.046

PITTSVILLE QUADRANGLE.

SNOW HILL, NORTHEAST TO BERLIN.

Newark, at southeast corner of Quenponco station of Philadelphia, Wilmington and Baltimore Railroad; iron post stamped "35 BALTO"	35.151

WANGO, NORTH TO MELSON; THENCE WEST TO DELMAR.

Parsonsburg, at northeast corner of Riggin's grocery store, 100 feet north of road; iron post stamped "80"	79.651

MELSON EAST VIA TWILLEY TO CAMPBELL.

Twilley, in yard at northwest corner of C. W. Lynch's store; iron post stamped "40 BALTO"	39.978

OCEAN CITY QUADRANGLE.

CAMPBELL, SOUTH TO BERLIN; THENCE WEST TO WANGO.

Campbell, inside of lot on the northwest intersection of roads, west of F. S. Campbell's store; iron post stamped "25 BALTO"	24.775
Berlin, on southwest corner of front step of Exchange Savings Bank; bronze tablet stamped "45 BALTO"	44.878

Belair, Elkton, Havre de Grace, and Parkton quadrangles.

BALTIMORE, CECIL, AND HARFORD COUNTIES.

The elevations in the following list are based on an aluminum tablet in the City Hall Building at Baltimore stamped "21," the height of which is accepted as 20.630 feet above mean sea level, as published in Bulletin 185. The stated elevation of this bench is as follows: By Baltimore City datum, 21.353; by Pennsylvania Railroad, 19.990; by Baltimore and Ohio precise levels, uncorrected, 20.939; by Baltimore and Ohio levels, corrected to 1903 adjustment at Washington, 20.745; and by Baltimore and Ohio levels, corrected to 1907 adjustment at Baltimore, 20.563. The accepted elevation was determined by applying 0.640 foot to Pennsylvania Railroad elevations between Elkton and Baltimore, approximately a mean correction derived from gages at Baltimore and Havre de Grace of the Coast and Geodetic Survey.

The leveling was done as follows: In Elkton quadrangle in 1896 by O. L. Pettibone; in Havre de Grace quadrangle in 1899 by C. M. Smith; in Belair quadrangle in 1899 by C. M. Smith and George Bailey, and in 1900 by J. W. Hodges; in Parkton quadrangle in 1899 by C. M. Smith and George Bailey, and in 1900 by J. W. Hodges, J. S. B. Daingerfield, and Hargraves Wood.

ELKTON QUADRANGLE.

BOHEMIA MILLS, NORTH TO ELKTON.

	Feet.
Chesapeake, entrance to George R. Ross's store, in north end of doorsill of hall; bronze tablet stamped "17"	17.857
Elkton; copper bolt on top of step of south entrance to court-house, marked "U.S.G.S.B.M. 28 ft."	28.578
Elkton, in doorsill of railroad station; copper bolt	30.14

ELKTON, NORTH TO APPLETON; THENCE WEST VIA FAIR HILL[a] TO CALVERT; THENCE SOUTH VIA ZION AND BAYVIEW[a] TO NORTHEAST POST-OFFICE; THENCE SOUTHWEST TO CHARLESTOWN.

Strayhorn's mills, 2 miles northwest of Appleton, southeast corner of stone wall, foundation of wagon shed; bronze tablet stamped "173"	173.913
Fairview, 3 miles east of, top of land boundary stone in center of road in front of Mahon's barn	410.50
Calvert, top of land boundary stone in churchyard	441.87
Calvert, in northwest corner John E. Crother's store; bronze tablet stamped "441"	441.820
Bayview, southwest corner of crossroads, foundation of W. L. Jones's boarding house; bronze tablet stamped "385"	385.388
Bayview, 1.5 miles south of, highest point, on land boundary stone west of road	204.53
Leslie, in front of Baltimore and Ohio Railroad station; top of rail	143.4
Charlestown station, 50 feet north of; copper bolt in northwest corner of northwest cornerstone of cattle guards, stamped "41"	41.530
Charlestown, 390 feet south of railroad station, northeast corner of box culvert, on coping stone; copper bolt (railroad bench mark 50)	41.19

HAVRE DE GRACE QUADRANGLE.

ABERDEEN, NORTHWEST TO CARSINS; THENCE NORTH VIA DARLINGTON TO CONOWINGO.

Aberdeen, at east end of box culvert at milepost 65; copper bolt (Philadelphia, Baltimore and Washington Railroad bench mark 62)	67.50
Aberdeen, in upper foundation stone of First National Bank of Aberdeen, southeast corner; aluminum tablet stamped "79 BALTO"	80.007
Darlington, 3 miles south of, in east foundation stone of Prospect schoolhouse; bronze tablet stamped "345 BALTO"	346.213
Conowingo, southwest bridge seat of county bridge; copper bolt (Philadelphia, Baltimore and Washington Railroad bench mark 11)	69.50
Conowingo, in foundation stone 2 feet from ground in northwest corner of post-office; aluminum tablet stamped "76 BALTO"	77.334

CONOWINGO, EAST TO RISING SUN; THENCE SOUTH TO PRINCIPIO.

Porter Bridge, in foundation stone 3 feet above ground, in southwest corner of J. W. Richards's mill; aluminum tablet stamped "89 BALTO"	89.327
Rising Sun, in foundation stone, north side of Worthington's store, 1 foot above ground; aluminum tablet stamped "387 BALTO"	387.565

PORT DEPOSIT, NORTHEAST VIA PRINCIPIO TO ZION.

Port Deposit, 0.9 mile south of, on northeast bridge seat of bridge 27; copper bolt (Pennsylvania Railroad bench mark 3)	5.70
Port Deposit, in northwest corner foundation stone of Port Deposit post-office and town hall building; aluminum tablet stamped "16 BALTO".	16.501
Principio, in southwest corner of foundation stone of H. R. Lynch's store, 2.5 feet from ground; aluminum tablet stamped "302 BALTO"	302.507

---

[a] Cross lines were run from Bayview via Pleasant Hill to Cowentown, and from Pleasant Hill to Fair Hill; but on these no standard bench marks were set.

PRINCIPIO, SOUTH TO PRINCIPIO FURNACE; THENCE SOUTHWEST TO HAVRE DE GRACE.

	Feet.
Principio Furnace, 0.7 mile west of post-office, stone monument east of road at southwest corner of property owned by W. H. Currier; marked on fence post at monument 211	212.07
Principio station, Philadelphia, Baltimore and Washington Railroad, in doorsill; copper bolt (railroad bench mark 53)	67.400
Havre de Grace, in southwest back wall of Susquehanna River Bridge; copper bolt (Philadelphia, Baltimore and Washington Railroad bench mark 57)	28.86
Havre de Grace, in southwest corner of Philadelphia, Baltimore and Washington Railroad station, about 8 feet above tracks; aluminum tablet stamped "35 BALTO"	35.730

BELAIR QUADRANGLE.

DARLINGTON, WEST TO SCARBORO; THENCE SOUTH TO FOUNTAIN GREEN.

Allibone (Sandy Hook), 0.5 mile north of, in southeast corner of Mrs. Webster's spring house, 3 feet above ground; aluminum tablet stamped "209 BALTO"	211.099
Belair, in steps of court-house; aluminum tablet stamped "394 BALTO" (Elevation by a spur west from Fountain Green)	395.650

BRADENBAUGH ALONG HIGHWAY SOUTHEAST TO FEDERAL HILL; THENCE NORTHEAST TO NEAR WHITEFORD; THENCE SOUTHEAST VIA MACTON TO SCARBORO.

Federal Hill, in southeast corner of foundation stone of J. F. Devoe's house opposite former post-office; aluminum tablet stamped "590 BALTO".	591.477
Pylesville, in foundation stone at northeast corner of Pyles's mill, about 4 feet above ground; aluminum tablet stamped "356 BALTO"	357.778
Macton, 0.1 mile south of, in foundation stone at northwest corner of J. M. McNabb's house, 4 feet above ground; aluminum tablet stamped "249 BALTO"	251.157

TAYLOR, EAST ALONG HIGHWAY VIA HIGH POINT, TO HICKORY.

High Point, in foundation stone on north side of High Point schoolhouse; aluminum tablet stamped "536 BALTO"	536.864

PARKTON QUADRANGLE.

BENTLEY, EAST ALONG HIGHWAY, TO BRADENBAUGH.

Bentley, 1,300 feet south of, in northwest wing wall of bridge 53; copper bolt (Pennsylvania Railroad bench mark 33)	502.110
Bentley, 0.5 mile north of, in northwest corner of Bentley Methodist Church; bronze tablet stamped "607 BALTO" (reported out of place December 11, 1907)	608.019
Trump, in north foundation of M. S. Van Trump's store, at edge of cellar; bronze tablet stamped "716 BALTO"	716.333
Shane, northwest corner of schoolhouse lot; stone marked "709"	709.26
Bradenbaugh, in stone foundation of former post-office, just to right of cellar entrance; bronze tablet stamped "BALTO 604"	605.149

SPARKS, EAST ALONG HIGHWAY, TO TAYLOR.

Sparks (Philopolis), 0.1 mile east of station, in southwest corner of Union Chapel, 1 foot above ground; bronze tablet stamped "BALTO 268"	268.434
Taylor, in southwest corner of S. Phelps's blacksmith shop, about 2 feet above ground; bronze tablet stamped "583 BALTO"	583.854

MONKTON, WEST TO MOUNT CARMEL AND RETURN.

	Feet.
Monkton, 0.5 mile north of, in center of east end of railroad box culvert; Pennsylvania Railroad bench mark 26	317.77
Mount Carmel, in foundation stone of porch of northeast corner of Miller's store and post-office; bronze tablet stamped "674 BALTO"	674.052

SPARKS, NORTH TO BENTLEY.[a]

Whitehall, in northwest corner of post-office, 2 feet above ground; bronze tablet stamped "348 BALTO"	348.229

Annapolis, Baltimore, Ellicott, Laurel, Relay, and Westminister quadrangles.

ANNE ARUNDEL, BALTIMORE, CARROLL, AND PRINCE GEORGES COUNTIES.

The elevations in the following list are based on an aluminum tablet in the City Hall, Baltimore, Md., the height of which is accepted as 20.630 feet above mean sea level (see previous list, p. 21). The leveling extends from various bench marks of the Baltimore and Ohio and the Pennsylvania Railroad companies in the vicinity, a correction of 0.2 foot having been subtracted from the Baltimore and Ohio Railroad elevations and 0.640 foot added to the Pennsylvania Railroad elevations.

The leveling was done as follows: In Annapolis, Baltimore, Ellicott, and Westminster quadrangles in 1902 by W. C. Palmer and W. G. Coates; in the Laurel and Relay quadrangles in 1904 and 1905 by J. W. Hodges and Ralph Hutchins; and in the Laurel quadrangle in 1906 by G. S. Buckley.

BALTIMORE QUADRANGLE.

AT CATONSVILLE.

	Feet.
Catonsville, State Insane Asylum, east face of southeast wing; bronze tablet stamped "396 BALTO"	395.954

AT PIKESVILLE.

Pikesville, main building of Soldiers' Home, just east of main entrance, in southwest corner of foundation wall; bronze tablet stamped "516 BALTO"	516.078

SHERWOOD, EAST ALONG HIGHWAYS VIA TOWSON TO A POINT 4.6 MILES EAST; THENCE VIA LAVENDER HILL (PARKVILLE) TO LAURAVILLE.

Sherwood, 100 feet south of station, in west end of east center of arch culvert; copper bolt (Pennsylvania Railroad bench mark)	284.269
Towson, on southeast cornerstone of court-house porch; bronze tablet stamped "465 BALTO"	465.371
Parkville, Kelchensten's store and post-office, northeast corner of foundation wall; bronze tablet stamped "343 BALTO"	343.438
Lauraville, near northeast corner of city boundary, J. C. Mann's wagon shop, on south end of doorsill; chiseled square	189.00

---

[a] Set from Pennsylvania Railroad elevations plus 0.64 foot.

TIMONIUM, EAST ALONG HIGHWAYS TO BOSLEY; THENCE SOUTHWEST TO TOWSON.

	Feet.
Timonium, 0.5 mile south of, 800 feet north of milepost 11, in west end of culvert; copper bolt (Pennsylvania Railroad bench mark 14)	357.216
Bosley, on southeast corner of Valley Hotel; bronze tablet stamped "223 BALTO"	222.955

AT MOUNT WASHINGTON.

Mount Washington, bridge 5, over Western Run, at northeast side on bridge seat; bronze tablet stamped "198 BALTIMORE 1900"	198.904

0.4 MILE NORTH OF REISTERTOWN, EAST ALONG HIGHWAYS VIA SHAWAN, TO COCKEYSVILLE.

Shawan, F. G. Wheeler's store and private residence, on southeast corner of foundation wall; bronze tablet stamped "439 BALTO"	439.108
Cockeysville, 150 feet southeast of signal station, on northeast corner of culvert; copper bolt (Pennsylvania Railroad bench mark 17)	278.838

PRECISE-LEVEL LINE OF BALTIMORE AND OHIO RAILROAD.

Landsdowne, east of, in large coping stone of retaining wall west end of north abutment to overhead bridge; copper bolt (bench mark 35)	79.285
West Baltimore, vertical rail section between tracks at station; bench mark 36	72.526
Mount Winans, vertical rail section between tracks; bench mark 37	37.046
Mount Winans, 0.5 mile east of, south tie stone west abutment bridge 3–A; copper bolt (bench mark 38)	21.826
Baltimore, near corner West Ostend and Sharp streets, in middle of south coping of small culvert; copper bolt (bench mark 39)	9.317
Camden, in offset of wall for elevated tracks, about 300 feet from west end of wall; copper bolt (bench mark 40)	25.318
Baltimore, corner Howard street and Fifth avenue; city elevation 127.851 (1288)	127.237
Mount Royal, in coping of retaining wall north of track, about 75 feet from end of tunnel; copper bolt (bench mark 41)	71.051
Mount Royal, 0.5 mile east of station, south end of east abutment of bridge over Pennsylvania Railroad (bench mark 42)	93.885
Milepost "Baltimore 3 miles," about 400 feet west of, south end of west abutment of small bridge; copper bolt (bench mark 43)	149.546
Telegraph pole 92–8, in north end of bridge seat of east abutment of large iron bridge; copper bolt (bench mark 44)	133.566
Gay street, on bridge seat south side of tracks west abutment of bridge at station; copper bolt (bench mark 45)	150.615
Duncans Lane Bridge, between tracks on bridge seat of west abutment, opposite telegraph pole 90–11; copper bolt (bench mark 46)	108.688
Bay View, bridge over Philadelphia road, north end of bridge seat of east abutment, 100 feet west of telegraph pole 89–20; copper bolt (bench mark 47)	72.839
Herring Run, in east abutment bridge 3 B, at telegraph pole 88–13; copper bolt (bench mark 48)	30.450
Rosedale, between tracks opposite milepost B 9; vertical rail section (bench mark 49)	45.832
Milepost "Balto. 10 miles," between tracks; vertical rail section (bench mark 50)	58.600

ELLICOTT QUADRANGLE.

ELLICOTT CITY, ALONG BALTIMORE AND OHIO RAILROAD AND HIGHWAYS, VIA HOLLOFIELD AND ROCKDALE, TO PIKESVILLE.

	Feet.
Ellicott City, southwest corner of court-house (south face); aluminum tablet stamped "233 BALTO"	233.412
Oella, at W. J. Dickey & Son's woolen mills, west of tracks, south bridge abutment of Baltimore and Ohio Railroad bridge over Patapsco River; chisel mark	150.05
Oella, 1.6 miles northwest of; copper bolt on southeast corner of west wing wall of Union dam, stamped "187"	187.779
Hollofield, 1.1 miles northwest of, public school No. 2, on Quaker Hill, on southwest corner of stone doorsill; chiseled shelf	456.47

ROCKDALE, WEST ALONG HIGHWAYS, TO WOODSTOCK; THENCE NORTH TO REISTERSTOWN.

Woodstock College, on west side of main entrance, over small window, on center stone; aluminum tablet stamped "415 BALTO"	415.157
Reisterstown, northwest corner stone of Russel's store; aluminum tablet stamped "735 BALTO"	735.458

WOODSTOCK, SOUTHWEST ALONG HIGHWAYS, TO WEST FRIENDSHIP; THENCE NORTH VIA SYKESVILLE TO GAMBER; THENCE EAST TO A POINT 3.8 MILES SOUTH OF REISTERSTOWN.

West Friendship, just west of post-office, on milestone 19 north of Frederick pike; bronze tablet stamped "476 BALTO"	476.193
Sykesville, in second step of Sykesville Bank; bronze tablet stamped "383 BALTO"	382.965
Gamber, on southeast corner of Mount Pleasant M. E. Church; bronze tablet stamped "606 BALTO"	605.738

PRECISE-LEVEL LINE OF BALTIMORE AND OHIO RAILROAD.

Ilchester, 0.25 mile west of Orange Grove station, in native rock north side of tracks, 250 feet west of milepost "12 miles;" copper bolt (bench mark 103)	95.158
Ilchester, between tracks in mud wall west of abutment bridge of Ilchester tunnel; copper bolt (bench mark 104)	109.342
Grays, between tracks opposite milepost "Balto. 14 miles," on old line at station; vertical rail section (bench mark 105)	121.657
Ellicott City, in native rock at south side of tracks, about 600 feet west of station; copper bolt (bench mark 106)	144.546
Oella, in center north coping of arch culvert about 400 feet east of station; copper bolt (bench mark 106A)	148.205
Oella, 0.75 mile west of, in native rock at south side of tracks, 40 feet east of telegraph pole 16–10; copper bolt (bench mark 107)	168.607
Union dam, in southeast corner of west wing wall; copper bolt (bench mark 108)	187.704
Union dam near bench mark No. 108; "U.S.G.S." on	187.779
Milepost "Baltimore 18 miles," 125 feet west of, 6 feet from east end of north coping of culvert; copper bolt (bench mark 109)	192.793
Hollofield, in west end of north coping of culvert near target at tower; copper bolt (bench mark 110)	200.166
Alberton, 0.75 mile west of Hollofield, in rock at south side of tracks, telegraph pole 19–34; copper bolt (bench mark 111)	215.883

	Feet.
Alberton, 0.2 mile west of, between tracks at west abutment of bridge 17; copper bolt (bench mark 112)	222.521
Dorseys Run, in center of south coping of arch culvert; copper bolt (bench mark 113)	237.222
Dorseys Run, ⅜ mile west of, in center of north coping of arch culvert 21; copper bolt (bench mark 114)	244.994
Dorseys Run, 1 mile west of, in center of north coping of arch culvert 22; copper bolt (bench mark 115)	249.574
Davis, in center of south coping of arch culvert 23; copper bolt (bench mark 116)	258.930
Woodstock, 500 feet east of station, in south end of abutment of small culvert; copper bolt (bench mark 117)	271.734
Milepost "Balto. 26 miles," between tracks at; vertical rail section (bench mark 118)	288.391
Telegraph pole 26–28, 20 feet west of, in retaining wall at north side of tracks; copper bolt (bench mark 119)	291.769
Marriottsville, in north end of west mud wall of bridge 25; copper bolt (bench mark 120)	293.010
Henrytown tunnel, 300 feet east of, bridge seat west abutment of bridge 26; copper bolt between tracks (bench mark 121)	299.329
Milepost "Balto. 29 miles," 100 feet west of, in north end of small box culvert; copper bolt (bench mark 122)	311.115
Gorsuch, in north end of west abutment of culvert 27, at station; copper bolt (bench mark 123)	323.806
Sykesville, between tracks, opposite milepost "Balto. 31 miles;" vertical rail section (bench mark 124)	351.240
Gaither, between tracks in bridge seat of bridge at west end of Sykesville tunnel; copper bolt (bench mark 125)	408.947
Gaither, 0.25 mile west of, in north end of west abutment of bridge 28; copper bolt (bench mark 127)	419.402

WESTMINSTER QUADRANGLE.

REISTERSTOWN, NORTH ALONG HIGHWAYS VIA WOODENSBURG AND FOWBLESBURG TO HAMPSTEAD; THENCE EAST TO MOUNT CARMEL.

Woodensburg, northeast corner of Methodist church; top of corner stone marked "A.D. 1888"	703.34
Fowblesburg station, Argile's store and post-office, in east foundation wall at center of building; bronze tablet stamped "703 BALTO"	702.951
Hampstead, private residence owned by C. W. Murray, in southwest corner of foundation wall; bronze tablet stamped "913 BALTO"	913.471

HAMPSTEAD, ALONG HIGHWAYS TO MELROSE; THENCE EAST TO ROCKDALE; THENCE SOUTH TO MOUNT CARMEL.

Manchester, 0.5 mile northwest of, just over center of stone culvert at first stream to right; square cut on stone	857.57
Rockdale, on northwest corner of paper mill; bronze tablet stamped "510 BALTO"	508.704

WOODENSBURG, SOUTHWEST ALONG HIGHWAYS, TO FINKSBURG; THENCE NORTHWEST TO WESTMINSTER.

Westminster, on fifth step of main entrance to court-house; bronze tablet stamped "774 BALTO"	774.537

ANNAPOLIS QUADRANGLE.

AT ANNAPOLIS.[a]

	Feet.
Annapolis, at Naval Academy, 8 feet southwest of Observatory building; top of stone pier (Coast and Geodetic Survey bench mark "OBS")..	23.012
Annapolis, corner of State House; aluminum tablet stamped "58 BALTO"	57.546

RELAY QUADRANGLE.

AT WINANS.

Winans, 780 feet south of Pennsylvania Railroad bench mark No. 101, east side of Baltimore and Ohio Railroad bridge........................	36.94

RELAY, EAST ALONG HIGHWAY TO PUMPHREY; THENCE ALONG MARYLAND ELECTRIC RAILWAY TO ELVATON; THENCE SOUTHWEST ALONG HIGHWAY TO BOWIE.

Relay, on Baltimore and Ohio Railroad viaduct, northeast face of northeast abutment; bronze tablet stamped "71 BALTO"........................	70.960
Pumphrey, in center of north foundation wall of station and store building; aluminum tablet stamped "51 ADJ 1903"........................	51.293
Glenburnie, 1.5 miles northeast of, on top of northwest retaining wall of highway bridge over Furnace Branch; aluminum tablet stamped "8 ADJ 1903"........................	7.737
Glenburnie, on northwest abutment of Furnace Branch bridge; cut (Maryland Geological Survey bench mark 9)........................	7.621
Elvaton, in corner of dwelling 50 feet west of store; copper nail (Maryland Geological Survey bench mark 12 B)........................	76.079
Elvaton post-office, 100 feet south of station, in north foundation of water tank; aluminum tablet stamped "69 ADJ 1903"........................	69.263
Benfield, in southeast foundation wall of D. L. Stone's house; aluminum tablet stamped "110 ADJ 1903"........................	109.297
Waterbury, 0.5 mile north of, in east wall of railway bridge over highway; aluminum tablet stamped "92 ADJ 1903"........................	91.604
Conaways, 0.3 mile northwest of, in southeast abutment wing wall of highway bridge over Little Patuxent River; aluminum tablet stamped "53 ADJ 1903"........................	52.531
Conaways, 4 miles northwest of, south abutment of Philadelphia, Baltimore and Washington Railroad bridge over Little Patuxent River; copper bolt........................	75.045

AT JONES STATION, ON MARYLAND ELECTRIC RAILWAY.[b]

Jones, in southeast corner of foundation of Mr. Jones's warehouse; aluminum tablet stamped "69 ADJ 1903"........................	68.148

AT ODENTON AND SEVERN STATIONS, ON PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD.

Odenton, inside yard at station, northwest corner; iron post stamped "160 ADJ 1903"........................	160.209
Severn, 20 yards east of station, 410 feet south of milepost 110, east of track; iron post stamped "167 ADJ 1903"........................	166.960

---

[a] Coast and Geodetic Survey bench mark "Woods" was checked by two independent lines from bench mark "OBS" and appears to have settled 0.34 foot; the doorstep was badly out of plumb.

[b] Set from adjusted Maryland State Geological Survey levels.

AT DORSEY.[a]

	Feet.
Dorsey, east of railroad, south of highway, in west foundation wall, northwest corner of store; aluminum tablet stamped "121 ADJ 1903"	120.644

PRECISE-LEVEL LINE OF BALTIMORE AND OHIO RAILROAD.

Dorsey, between tracks opposite milepost "Balto. 14;" vertical rail section (bench mark 26)	137.277
Harwood, 400 feet west of milepost "Balto. 13 miles," west end north coping of culvert; copper bolt (bench mark 27)	116.924
Hanover, 450 feet east of milepost "Balto. 12 miles," at middle of south coping of arch culvert abutment; copper bolt (bench mark 28)	88.370
Milepost "Balto. 11 miles," between tracks opposite; vertical rail section (bench mark 29)	81.013
Elk Ridge, 30 feet west of milepost "Balto. 10," in coping of retaining wall south of tracks; copper bolt (bench mark 30)	71.271
Relay (St. Denis), in center of stone post at east end of Viaduct Branch, south of tracks at Relay; copper bolt (bench mark 31)	71.886
St. Denis, 0.1 mile east of, at middle of south coping of arch culvert; copper bolt (bench mark 31A)	67.862
Halethorpe, 0.3 mile east of St. Denis, in first course of stone at east end of north abutment road crossing; copper bolt (bench mark 32)	74.068
Telegraph pole 5–20, south end of west wall of culvert; copper bolt (bench mark 33)	67.972
Landsdowne, elevation given by Pennsylvania Railroad, 36.15	36.939
Landsdowne, opposite milepost "Balto. 4 miles;" vertical rail section (bench mark 34)	69.105
Avalon, 0.5 mile west of Relay station, northwest corner culvert; copper bolt (bench mark 100)	66.803
Vineyard, at east end of south coping of bridge 10; copper bolt (bench mark 101)	71.143
Orange Grove, in east end of west offset of south coping of bridge 11; copper bolt (bench mark 102)	77.228

LAUREL QUADRANGLE.

AT BOWIE.

Bowie, in south foundation wall of Imperial Hotel; aluminum tablet stamped "154 ADJ 1903"	153.878
Bowie, on stone east of tower east of Philadelphia, Washington and Baltimore Railroad track; copper bolt	148.658

BALTIMORE AND OHIO RAILROAD PRECISE LINE.[b]

Laurel, on southwest corner of Main street and Washington avenue, in east face at northeast corner of large brick store building, 3 feet above ground; aluminum tablet stamped "156 ADJ 1903"	155.584
Waterloo, at northeast corner of crossroads, in southeast corner of south foundation wall of house; aluminum tablet stamped "232 ADJ 1903"	231.661
Annapolis Junction, in east foundation wall of north abutment of overhead bridge; copper bolt	174.660
Annapolis Junction, in southeast face of central brick foundation pier of warehouse of Alphonso Latchford; aluminum tablet stamped "171 ADJ ".	170.869

---

[a] Set in 1905 and rechecked in 1906 from adjusted elevation of the Baltimore and Ohio Railroad precise line.

[b] Bench marks set in 1905 and rechecked in 1906.

ELLICOTT CITY, SOUTHWEST ALONG HIGHWAY, TO CLARKSVILLE.

	Feet.
Columbia, in south foundation wall of post-office building; aluminum tablet stamped "402 ADJ 1904"	402. 548
Elioak, in southeast corner of foundation wall of store and post-office; aluminum tablet stamped "433 ADJ 1904"	432. 867
Clarksville, in southeast corner of stone building, store and post-office, 2 feet above ground; aluminum tablet stamped "487 ADJ 1904"	486. 870

AMMENDALE, WEST ALONG HIGHWAY, TO FAIRLAND; THENCE NORTH TO BURTONSVILLE; THENCE NORTHWEST TO ASHTON; THENCE NORTHEAST TO CLARKSVILLE.

Ammendale, between Baltimore and Ohio railroad tracks, opposite milepost "Baltimore 26 miles;" vertical rail section	137. 910
Ammendale, in southeast corner of Lasalle Academy building; aluminum tablet stamped "182"	182. 040
Ammendale, 3.2 miles northwest of, at main crossroads in woods, 15 feet east of roads; iron post stamped "279"	279. 018
Fairland, 50 feet east of road, southwest corner of frame house, in foundation; aluminum tablet stamped "414"	413. 996
Burtonsville, 0.3 mile northwest of, northwest corner of Liberty Grove Church; aluminum tablet stamped "482"	481. 989
Spencerville, 0.1 mile west of, 60 feet south of road, 2 feet from northeast corner of house, in stone; aluminum tablet stamped "516 B"	516. 464
Ashton, 2.4 miles northeast of, Snell Bridge over Patuxent River, at south end of west abutment, in bridge seat; aluminum tablet stamped "294".	293. 576

PRECISE-LEVEL LINE OF BALTIMORE AND OHIO RAILROAD.

Berwyn, 0.25 mile west of, in north end of bridge seat of east abutment of small bridge, telegraph pole 30–17; copper bolt (bench mark 9A)	53. 081
Branchville, 0.24 mile east of, at west end of south coping of box culvert, telegraph pole 20–24; copper bolt (bench mark 10)	65. 730
Milepost 29B, between tracks opposite; vertical rail section (bench mark 11)	77. 598
Sunnyside, 0.5 mile east of, in south coping of culvert, telegraph pole; copper bolt (bench mark 12)	101. 392
Beltsville, 0.6 mile east of, north end of bridge seat, east abutment of bridge, telegraph pole 26–20; copper bolt (bench mark 13)	125. 505
Milepost "Balto. 26 miles," between tracks opposite; vertical rail section (bench mark 14)	137. 910
Telegraph pole 25–7, middle of south coping of culvert opposite; copper bolt (bench mark 14A)	152. 711
Muirkirk, at west end of foundation of south abutment to overhead bridge; copper bolt (bench mark 15)	157. 744
Contee, opposite milepost "Baltimore 24 miles;" vertical rail section between tracks (bench mark 16)	179. 354
Telegraph pole 23–11, at north end of bridge seat at east abutment of bridge; copper bolt (bench mark 17)	176. 008
Mistletoe Springs, center of south coping of culvert, at telegraph pole 22–24; copper bolt (bench mark 17A)	169. 774
Telegraph pole 21–30, in south end of east abutment of bridge; copper bolt (bench mark 18)	155. 212
Laurel, in south end of bridge seat at east abutment of bridge 6; copper bolt (bench mark 19)	149. 314
Savage, between tracks opposite milepost "Balto. 20 miles;" vertical rail section (bench mark 20)	173. 002

	Feet.
Annapolis Junction, at telegraph pole 19–18, in south end of east abutment of bridge 5; copper bolt (bench mark 21)	154. 412
Annapolis Junction, in east end of foundation of north abutment of overhead bridge; copper bolt (bench mark 22)	174. 660
Milepost "Balto. 17 miles," between tracks opposite; vertical rail section (bench mark 23)	170. 478
Jessup, 0.1 mile east of Bridewell, west end of north coping of arch front of south building; copper bolt (bench mark 24)	168. 798
Montevideo, opposite milepost "Balto. 15 miles;" vertical rail section (bench mark 25)	158. 454

Ijamsville, Mount Airy, Rockville, and Seneca quadrangles.

FREDERICK, HOWARD, AND MONTGOMERY COUNTIES.

The elevations in the following list are based on the Baltimore and Ohio precise levels corrected by subtracting 0.2 foot, to agree approximately with the 1903 adjustment at Washington. Many of the Baltimore and Ohio Railroad bench marks in this area are included.

The leveling in Ijamsville, Mount Airy, and Seneca quadrangles was done in 1906 by R. A. Farmer; in Rockville quadrangle partly in 1904 by Ralph Hutchins and partly in 1906 by T. A. Green and W. O. Tufts.

MOUNT AIRY QUADRANGLE.

CEDAR GROVE, NORTHEAST ALONG HIGHWAY, TO MOUNT AIRY.

	Feet.
Damascus, Dr. B. F. Lansdale's house, southeast corner of foundation; tablet stamped "845"	845. 802
Ridgeville, Nelson's Hotel, southeast corner of coping of yard; tablet stamped "817"	817. 264

MOUNT AIRY, NORTHWEST ALONG HIGHWAY, TO CROSSROADS 1 MILE NORTH OF NEW LONDON; THENCE NORTH TO LIBERTYTOWN; THENCE EAST TO WINFIELD; THENCE SOUTH TO WOODBINE.

Libertytown, Mrs. Carter's house, northeast corner of foundation; tablet stamped "523"	524. 024
Unionville schoolhouse, 8 feet east of main entrance, in stone foundation; tablet stamped "450 MARYLAND"	450. 200
Taylorsville, 1.5 miles west of, in south wall of Franklin schoolhouse; primary-traverse station 46A, stamped "882"	882. 952
Taylorsville schoolhouse, at northeast corner, in foundation; aluminum tablet stamped "819"	819. 693
Day, in east foundation of church, at southeast corner; tablet stamped "768"	769. 215
Woodbine, at milepost 37; vertical rail section (Baltimore and Ohio Railroad bench mark 131, elevation, 486.338)	491. 146
Woodbine, 1.5 miles east of, at milepost 36; vertical rail (Baltimore and Ohio Railroad bench mark 130)	460. 909

WOODBINE, SOUTH ALONG HIGHWAY, TO UNITY.

Lisbon, at southwest corner of Mr. Lascey's house, on east side of wagon road, in foundation; tablet stamped "591"	592. 132
Florence, northeast corner of store, in foundation; tablet stamped "627"	628. 006

PRECISE-LEVEL LINE OF BALTIMORE AND OHIO RAILROAD.

	Feet.
Hoods Mills, 100 feet west of milepost "Balto. 34 miles," at south end of small culvert; copper bolt (bench mark 128)	428.266
Hoods Mills, in large rock south side of track at dam; copper bolt (bench mark 129)	442.005
Woodbine, about 300 feet west of station, in northeast corner of culvert; copper bolt (bench mark 131A)	496.039
Mount Airy, at east end of cut-off, between tracks in bridge seat of east abutment of bridge; copper bolt (bench mark 133)	550.680
Watersville, 0.25 mile west of, in north coping of culvert abutment, on Mount Airy cut-off; copper bolt (bench mark 134)	593.688
Mount Airy cut-off, in west end of south coping of culvert at east end of cut; copper bolt (bench mark 135)	622.228
Mount Airy tunnel, 0.5 mile west of, east end south coping of culvert; copper bolt (bench mark 137)	657.502
Plane No. 4, 250 feet east of, in east end of north coping arch; copper bolt (bench mark 138)	581.481
Bartholows, 500 feet west of milepost "Balto. 47 miles," in east end of small culvert south of tracks; copper bolt (bench mark 139)	550.317
Bartholows, 300 feet west of, in west end of north coping of arch road crossing; copper bolt (bench mark 140)	528.570
Small culvert, in north end of, about 400 feet west of crossing of old and new tracks; copper bolt (bench mark 141)	489.661

IJAMSVILLE QUADRANGLE.

CLARKSBURG, NORTHWEST TO FREDERICK JUNCTION.

Hyattstown, south abutment of bridge over Little Bennetts Creek, southeast corner of bridge seat; tablet stamped "362"	361.950
Urbana, at west wall near northwest corner of former post-office; tablet stamped "468"	467.831
Frederick Junction, highway bridge over Monocacy River, southwest corner of south abutment, in southwest coping stone; tablet stamped "253".	253.237
Frederick Junction, Baltimore and Ohio Railroad bridge over Monocacy River, east abutment, northeast mud wall; copper bolt	266.313

FREDERICK JUNCTION, NORTH TO CHARLESVILLE; THENCE EAST VIA WALKERSVILLE AND MOUNT PLEASANT TO LIBERTYTOWN.

Frederick, 300 feet east of station, about 15 feet south of track, in natural rock; copper nail (Baltimore and Ohio Railroad precise-level mark)	289.464
Frederick, south side of Church street, between North Market and Court streets, Jacob Rohrback's residence and office, stoop to office, top step, southwest corner; tablet stamped "296"	295.835
Charlesville, bridge over Tuscarora Creek, southwest coping stone of south abutment; tablet stamped "367"	366.875
Walkersville, 2 miles west of, north end of center pier of bridge over Monocacy River, primary-traverse station 547; tablet stamped "283"	283.101
Walkersville, Walkersville Savings Bank, in front wall, 2 feet below window sill; tablet stamped "320"	319.834
Mount Pleasant, Clayton Zimmerman's brick store, 2 feet below window sill; tablet stamped "475"	475.361
Libertytown, 2.5 miles southwest of, crossroads at Chestnut Grove School No. 5, south foundation wall near west corner of schoolhouse, 0.5 foot above ground; tablet stamped "619"	619.017

AT CROSSROADS 1.2 MILES NORTH OF NEW LONDON.

	Feet.
New London, 1.2 miles north of, at northwest corner of road crossing on Libertytown pike, in flint rock 1 by 2 by 3 feet; aluminum tablet stamped "519"	519.120
Monrovia, 300 feet west of, precise-level line of Baltimore and Ohio Railroad between tracks at east bridge seat; copper bolt (bench mark 143)	427.422
Milepost "Balto. 51 miles," 40 feet east of, in north end of east bridge seat; copper bolt (bench mark 144)	391.191
Telegraph pole 51–23, at center of north coping of arch culvert; copper bolt (bench mark 145)	377.312
Telegraph pole 52–19, 20 feet east of, at north end of small culvert; copper bolt (bench mark 146)	360.284
Milepost "Balto. 54 miles," between tracks at east bridge seat; copper bolt (bench mark 148)	329.728
Ijamsville tunnel, at west end of, between tracks in west bridge seat of new bridge; copper bolt (bench mark 149)	315.212
Reels Mill, 1 mile east of, between tracks in west bridge seat at bridge; copper bolt (bench mark 150)	291.974
Reels Mill, in foundation stone southwest corner of coal chute; copper bolt (bench mark 151)	274.228
Frederick Junction, in north end of mud wall of east abutment of Monocacy River Bridge; copper bolt (bench mark 152)	266.313
Frederick, about 2.5 miles from, in south end of west coping of culvert; copper bolt (bench mark 152A)	285.117
Frederick Station, in rock east of tracks, end of cut abutment halfway to Frederick Junction; copper bolt (bench mark 152B)	302.745
Frederick, about 300 feet south of station, in native rock west of tracks; copper bolt (bench mark 152C)	289.464
Telegraph pole 58–34, 50 feet east of, in west end south coping of culvert; copper bolt (bench mark 153)	252.400
Frederick Junction, 1.5 miles west of, in west end of north coping of culvert 36; copper bolt (bench mark 153A)	251.410
Buckeystown, in west end of north coping of culvert at Buckeye Station; copper bolt (bench mark 156A)	282.326
Doubs, about 275 feet west of milepost "Balto. 65 miles," in center of north coping culvert 36½; copper bolt (bench mark 159)	285.687

ROCKVILLE QUADRANGLE.

ASHTON, WEST TO SANDY SPRING AND RETURN.

Sandy Spring, 30 feet south of road, granite slab at entrance to the office of the Mutual Fire Insurance Company; aluminum tablet stamped "484"	483.835

CLARKSVILLE, WEST ALONG HIGHWAY, TO GERMANTOWN.

Clarksville, 3.9 miles southwest of, north of highway, at Patuxent River, 50 feet west of center of bridge, 2.5 feet from east end of large flat rock; aluminum tablet stamped "316 ADJ 1904"	315.966
Unity, 35 feet west of former post-office, in northeast foundation wall of Ernest Gregg's tenant house, south of highway; aluminum tablet stamped "520 ADJ 1904"	520.158
Unity, 2.1 miles southwest of, at Hawlings River, in west end of northeast abutment on bridge seat, 1.7 feet below floor surface; aluminum tablet stamped "457 ADJ 1904"	457.082

	Feet.
Laytonsville, in south foundation wall of store and post-office, at northwest corner of crossroads; aluminum tablet stamped "615 ADJ 1904"	615.233
Goshen, in southwest corner of foundation wall of store; aluminum tablet stamped "425 ADJ 1904"	425.189
Brink, in east foundation wall of W. T. Dowden's residence; aluminum tablet stamped "627 ADJ 1904" (primary-traverse station)	627.239

BRINK, NORTH TO CEDAR GROVE.

Cedar Grove, in foundation at northwest corner of Upper Seneca Baptist Church, 1 foot above ground; tablet stamped "637"	637.309

KENSINGTON, NORTH ALONG HIGHWAY VIA AN INDIRECT ROUTE TO OLNEY; THENCE NORTHWEST TO LAYTONSVILLE.

Kensington, between tracks at milepost "W. 11;" top of vertical rail section (Baltimore and Ohio Railroad bench mark 12)	300.741
Kensington, 1 mile northwest of, between tracks at milepost "W. 12;" top of vertical rail section (Baltimore and Ohio bench mark 13)	285.566
Garrett Park, 60 feet south of road crossing; top of west rail	300.0
Wheaton, on south side of store kept by J. C. Cissel; aluminum tablet stamped "459"	459.133
Layhill, in south face at southeast corner of foundation of store kept by W. P. Beal; aluminum tablet stamped "438"	437.710
Norbeck, south of road, west of forks, in north foundation wall of Arthur Stonestreet's store; aluminum tablet stamped "499"	499.038
Olney, near southwest corner of town hall, in west face; aluminum tablet stamped "544"	543.573
Olney, 2.6 miles northwest of, at road forks, in east face at northeast corner of house owned and occupied by Thomas Griffit; aluminum tablet stamped "523"	522.795

ROCKVILLE, SOUTHWEST ALONG HIGHWAY TO GREAT FALLS.

Rockville, opposite milepost 17; top of vertical rail section (Baltimore and Ohio Railroad bench mark 18)	442.340
Rockville, top of corner stone in north side of court-house, 12 feet east of entrance, in granite foundation, 1 foot below water table; aluminum tablet stamped "451"	451.046
Rockville, 3.9 miles southwest of, road forks east, chimney at north side of schoolhouse; aluminum tablet stamped "420"	420.120
Potomac, 100 feet southwest of crossroads, in north side of chimney, east side of house of Mr. Perry; aluminum tablet stamped "364 ADJ 1903"	363.751
Great Falls, on the capstone near west end of south wall of Lock No. 20, Chesapeake and Ohio Canal, 0.200 meter from extreme north and 0.450 meter from extreme east edge of lock, 1.65 meters from west gate; bottom of square	166.647

AT WASHINGTON GROVE AND GAITHERSBURG.

Washington Grove, between tracks opposite milepost 21; rail (Baltimore and Ohio bench mark)	518.901
Gaithersburg, R. A. Young's store, northwest corner Fredericksburg avenue and Chestnut street; primary-traverse tablet stamped "508"	507.891

SENECA QUADRANGLE.

AT GERMANTOWN.

Germantown, 50 feet south of bridge over railroad, west of road, east face at northeast corner of house occupied by C. E. Keeper and owned by H. D. Waters; aluminum tablet stamped "449"	449.387

	Feet.
Germantown, in front of station; top of rail	429. 60
Germantown, 0.6 mile northwest of, at milepost "W. 27"; top of vertical rail section	442. 235

GAITHERSBURG, SOUTHWEST TO DARNESTOWN; THENCE WEST TO POOLESVILLE; THENCE NORTH TO BARNESVILLE.

Darnestown, Windsor store, brick foundation to cellar door; tablet stamped "436"	435. 879
Dawsonville, in north wall of Allnut ice house; tablet stamped "305"	305. 300
Poolesville, in south wall of T. R. Hall's brick house; tablet stamped "415"	414. 699
Barnesville, 0.25 mile east of, at milepost 33 on Baltimore and Ohio Railroad; vertical rail	509. 066

POOLESVILLE, SOUTHWEST TO EDWARDS FERRY.

Edwards Ferry, Chesapeake and Ohio Canal Lock No. 25, southwest corner; primary-traverse tablet station 88 stamped "207"	206. 475

BRINK, NORTHWEST TO CLARKSBURG.

Clarksburg, near southwest corner of west foundation wall of M. E. Church South; aluminum tablet stamped "658"	658. 562

WASHINGTON, D. C., TO WASHINGTON JUNCTION.

Milepost "W. 37," at southeast corner of culvert; copper bolt (bench mark 38) 225 feet west of	284. 790
Tuscarora, 150 feet west of milepost 39, south end of east wall of box culvert; copper bolt (bench mark 40A)	226. 476

Middletown and Martinsburg quadrangles.

FREDERICK AND WASHINGTON COUNTIES.

The following elevations are based on precise-level lines of the Coast and Geodetic Survey and the Baltimore and Ohio Railroad which traverse this area. Elevations in Virginia for Middletown quadrangle are given on page 62, and those in West Virginia have been published in Bulletin 399.

The leveling was done mostly in 1907 by W. R. Winstead; but some work was done in each quadrangle in 1908 by J. M. Harris.

MIDDLETOWN QUADRANGLE.

HARPERS FERRY, EAST ALONG BALTIMORE AND OHIO RAILROAD, TO BRUNSWICK; THENCE NORTH ALONG HIGHWAY, TO PETERSVILLE; THENCE EAST TO JEFFERSON; THENCE SOUTH TO POINT OF ROCKS.

	Feet.
Harpers Ferry, 0.6 mile east of, about 2.5 miles west of Weverton, about 400 feet east of Harpers Ferry tunnel, 300 feet west of milepost "B. 81," in box culvert on south side of railroad, in southeast abutment; iron plug (Baltimore and Ohio bench mark 56)	280. 462
Sandy Hook, south track in front of station; top of south rail marked "270.U.S."	270. 2
Sandy Hook, 0.5 mile east of, 170 feet west of milepost "B.80," in center of double track; iron rod with "X" on top driven in ground, marked "264 U.S.B.M."	264. 33
Weverton, 125 feet west of station, 50 feet west of road crossing, 15 feet north of track, in southwest pillar of Baltimore and Ohio Railroad water tower; aluminum tablet stamped "MARYLAND-260-ADJ"	259. 785

	Feet.
Weverton, 2.8 miles east of, 1,000 feet west of Brunswick station, on northeast corner of north abutment of culvert; point marked "250 U.S.B.M.".	249. 78
Brunswick, north track at street crossing; top of north rail marked "249.5 U.S."	249. 4
Brunswick, opposite post-office, in southeast corner of Savings Bank; aluminum tablet stamped "MARYLAND-266-ADJ"	266. 416
Petersville, 0.2 mile east of, at public road fork, in front face of east side of Lutheran Church; aluminum tablet stamped "MD-524-ADJ"	523. 505
Petersville, 2.4 miles east of, at foot of hill, south side of east end of covered bridge over Catoctin Creek, on top of large iron bolt; point marked "291 U.S.B.M."	290. 72
Jefferson, 300 feet west of electric car station, at Frederick-Picke-Catoctin road fork, northwest corner of schoolhouse; aluminum tablet stamped "MARYLAND-583-ADJ"	582. 967
Jefferson, 1.6 miles south of, at foot of hill at road fork to Catoctin station; large iron bolt in southwest abutment of iron bridge over stream, marked "417"	416. 76
Jefferson, 2.5 miles south of, at foot of hill, 600 feet west of brick house, on top of northeast abutment of bridge over creek; point marked "454"	454. 03
Jefferson, 3.9 miles south of, at foot of hill, about 1,000 feet north of W. C. Adams's residence, in west abutment of culvert over small stream; aluminum tablet stamped "MARYLAND-389-ADJ"	388. 538

WEVERTON, ALONG HIGHWAY NORTH, TO POINT 2.7 MILES NORTH OF ROHERSVILLE; THENCE EAST TO MIDDLETOWN; THENCE SOUTH TO JEFFERSON.

Weverton, 1.7 miles north of, 400 feet north of stream, road fork west at top of hill, road fork east, on top of stone at blacksmith shop; point marked "545"	544. 72
Brownsville, at road fork east, northwest corner of post-office; aluminum tablet stamped "533"	532. 372
Gapland, 100 feet north of station, on rock near telephone pole; point marked "619.5"	619. 30
Rohersville, 10 feet south of main entrance of post-office, southeast corner of front face; aluminum tablet stamped "624"	624. 056
Rohersville, 1.8 miles north of, on northeast corner of southwest abutment of bridge over stream; point marked "480"	479. 90
Rohersville, 2.8 miles north of, 400 feet west of T road, 30 feet north of road, in stone; aluminum tablet stamped "MARYLAND-508-ADJ"	507. 578
Rohersville, 5 miles northeast of, at top of mountain, in front of house at second-class crossroads, 4 feet north of road, on top of stone; point marked "1059"	1,058. 64
Bolivar, at crossroads, at southwest corner of stone-arch bridge over stream, on top of rock; point marked "517"	517. 15
Bolivar, 1.1 miles northeast of, at foot of hill, at southwest end of culvert over small stream, in front of brick house, on top of land line stone; point marked "445.6"	445. 35
Middletown, in front face of post-office building; aluminum tablet stamped "MARYLAND-547-ADJ"	546. 813
Middletown, 2.7 miles south of, at foot of hill near small stream, 200 feet west of house, 250 feet north of creamery, 15 feet west of road, in top of large rock; aluminum tablet stamped "MARYLAND-482-ADJ"	481. 682
Middletown, 4.6 miles south of, at foot of hill, at second-class crossroads, on northeast abutment of bridge over stream; point marked "432"	431. 44

HARPERS FERRY, NORTH TO ANTIETAM CREEK.

	Feet.
Harpers Ferry, 0.9 mile north of, 300 feet east of lock on canal, at second-class road fork northeast, 10 feet west of road, on top of large rock; point marked "276"	275.86
Harpers Ferry, 3.3 miles north of, at foot of hill, on northwest abutment of bridge over stream; point marked "422"	421.48
Harpers Ferry, 4.2 miles north of, at crossroads near schoolhouse and church, in front face of schoolhouse 4 feet east of main entrance; aluminum tablet stamped "MARYLAND-623-ADJ"	623.104
Harpers Ferry, 6.6 miles north of, on northwest corner of Chesapeake and Ohio Canal lock; point marked "300"	300.13
Harpers Ferry, 7.9 miles north of, at Antietam Creek, in northwest end of west abutment of Chesapeake and Ohio Canal aqueduct; aluminum tablet stamped "MD-301-ADJ"	300.470

SHARPSBURG, NORTHEAST TO KEEDYSVILLE; THENCE SOUTHEAST TO POINT 2.7 MILES NORTH OF ROHERSVILLE.

Sharpsburg, in front face of post-office building, 20 feet north of main entrance; aluminum tablet stamped "MARYLAND-413-ADJ"	413.077
Sharpsburg, 1.4 miles northeast of, at foot of hill, 300 feet southwest of tollgate; nail in center of north side of iron bridge over Antietam Creek, marked "337"	336.95
Keedysville, 50 feet north of railroad, in front face of hotel; aluminum tablet stamped "MARYLAND-404-ADJ"	403.687
Keedysville, 1 mile southeast of, at road fork north, at arch bridge over small stream; center of stone marked "402.5"	402.30

MYERSVILLE, SOUTH TO MIDDLETOWN.

Myersville, 2.3 miles south of, north-south road, T road east, on top of large rock in northeast corner between county road and railroad; chiseled square marked "G.S. □ 644 B.M."	644.06
Mount Tabor, in front of station; top of rail	584.5
Mount Tabor, 330 feet southwest of, in northeast corner of Peter Leatherman's brick house; aluminum tablet stamped "588 MD"	587.758

MARTINSBURG QUADRANGLE.

ANTIETAM, WEST ALONG HIGHWAY, TO SHEPHERDSTOWN, W. VA.; THENCE NORTHEAST TO SHARPSBURG; THENCE NORTH TO GRIMES.

Shepherdstown, 1.3 miles northeast of, 150 feet west of second-class road crossing, 100 feet west of barn, on northwest abutment of culvert of Norfolk and Western Railway; point marked "430"	429.58
Grimes, 1.2 miles south of, 500 feet south of county road crossing, west of railroad at cut, on large rock; chiseled square marked "G.S. □ B.M. 415"	415.10
Grimes, 2.2 miles south of, on east side of railroad in north mouth of cut, on top of rock; chiseled square marked "G.S. □ B.M. 412"	411.46
Mondel, in front of station; top of rail	418.8
Mondel, 2 miles south of, on east side at north end of cut, on top of rock; chiseled square marked "G.S. □ B.M. 458"	457.39
Sharpsburg, in front face of post-office building, 20 feet north of main entrance; aluminum tablet stamped "ADJ 413"	413.077

Emmitsburg, Hagerstown, Taneytown, and Williamsport quadrangles.

CARROLL, FREDERICK, AND WASHINGTON COUNTIES.

The following elevations were determined by primary leveling extended from Baltimore and Hagerstown and from the Baltimore and Ohio precise-level line from Relay to Washington Junction. The leveling was done in 1908, as follows: In Taneytown quadrangle and most of Emmitsburg quadrangle, by C. H. Semper; in Hagerstown and Williamsport quadrangles and part of Emmitsburg quadrangle, by J. M. Harris. The standard bench marks are stamped with the state name.

TANEYTOWN QUADRANGLE.

WESTMINSTER, WEST ALONG WESTERN MARYLAND RAILROAD, TO DETOUR.

	Feet.
Westminster, in fifth step of main entrance to court-house; bronze tablet stamped "774"	774.537
Spring Mills, in front of station sign; top of rail	607.2
Spring Mills, 250 feet west of station, at east end of north side of railroad culvert on top of mud wall; chiseled square marked "U.S. □ B.M. 602"	602.31
Avondale, in front of station; top of rail	560.5
Avondale, 210 feet west of station, on north side of track, on top of railroad culvert; chiseled square marked "U.S. □ B.M. 559"	558.77
Medford, in northwest corner of foundation of C. E. Engle's building at station; aluminum tablet stamped "531"	531.401
Medford, in front of station; top of rail	530.0
Wakefield, in front of station; top of rail	515.9
New Windsor, 1.4 miles east of, south of track, on top of railroad culvert; chiseled square marked "U.S. □ B.M. 501"	500.95
New Windsor, 0.3 mile east of, north side of east abutment of railroad bridge, in top of second step of retaining wall; aluminum tablet stamped "452"	451.991
New Windsor, in front of station; top of rail	445.7
Linwood, in front of station; top of rail	415.8
Union Bridge, 0.8 mile east of, north side of east abutment of railroad bridge, on top of retaining wall; chiseled square marked "U.S. □ B.M. 405"	404.56
Union Bridge, at railroad station, in southeast corner of front face of First National Bank; aluminum tablet stamped "402"	402.204
Union Bridge, in front of station; top of rail	399.2
Middleburg, 1.5 miles east of, in top of bridge seat of east abutment on north side of railroad culvert; aluminum tablet stamped "398"	398.380
Middleburg, in front of station; top of rail	461.6
Bruceville, in front of station; top of rail	453.1
Detour, in front of station; top of rail	349.1

LADIESBURG, NORTHEAST ALONG NORTHERN CENTRAL RAILWAY, TO KINGSDALE.

Ladiesburg, in front of station; top of rail	482.5
Ladiesburg, 1.6 miles north of, south abutment of steel railway bridge, east of track, in top of retaining wall; aluminum tablet stamped "403"	403.080
Bruceville, 50 feet north of overhead crossing of Western Maryland Railroad, 6 feet east of track, on concrete foundation to brick gasoline house, chiseled square marked "U.S. □ B.M. 433"	433.42
Bruceville, in front of station; top of rail	434.1

	Feet.
Sharretts, in front of station sign; top of rail	418.9
Crabster, in front of station sign at crossing; top of rail	513.4
Taneytown, Baltimore street crossing railroad, east of track, south of road, foundation of railroad-crossing sign; chiseled square marked "U.S. □ B.M. 501"	500.71
Taneytown, in southwest corner of Central Hotel; aluminum tablet stamped "524"	523.476
Taneytown, in front of station; top of rail	500.6
Taneytown, 1.9 miles north of, at railway crossing, 10 feet east of track, north of road, foundation of crossing sign; aluminum tablet stamped "494"	493.783
Galt, at station, west of track, south of road, foundation of crossing sign; chiseled square marked "U.S. □ B.M. 535"	534.47
Piney Creek, in front of station; top of rail	513.4

KINGSDALE, SOUTHEAST TO UNION MILLS.

Kingsdale, 3.6 miles southeast of, on Baltimore pike, in northwest corner of front face of F. T. Brown's brick house; aluminum tablet stamped "705"	704.572
Union Mills, in foundation on northwest side of Shriver's grain mill, 2 feet from corner; bronze tablet stamped "546"	544.545

EMMITSBURG QUADRANGLE.

WALKERSVILLE, NORTHEAST ALONG NORTHERN CENTRAL RAILWAY, TO LADIESBURG.

McAleer, in front of station; top of rail	344.3
Woodsboro, in front of station; top of rail	410.1
Woodsboro, at railway station, in northeast corner of foundation of flour mill; aluminum tablet stamped "411"	411.302
Le Gore, in front of station; top of rail	434.2
New Midway, at station, at road crossing, 8 feet east of track, 6 feet north of highway, foundation of railway crossing sign; aluminum tablet stamped "462"	461.656
New Midway, in front of station; top of rail	463.6

DETOUR, WEST AND NORTHWEST ALONG WESTERN MARYLAND RAILROAD, TO THURMONT AND BUENA VISTA SPRING.

Detour, 1,300 feet west of station, at road crossing, north of track, on outcrop; chiseled square marked "U.S. □ B.M. 341"	341.10
Detour, 0.35 mile north of, at railroad crossing, in east face about 6 feet from southeast corner of stone foundation to E. D. Diller's house; aluminum tablet stamped "Prim. Trav. Sta. No. 1, 447"	447.316
Detour, 1.5 miles west of, on south wall of west abutment of railroad bridge over river; chiseled square marked "U.S. □ B.M. 335"	335.04
Detour, 2.7 miles west of, 20 feet north of track, east of overhead bridge, on large rock; chiseled square marked "U.S. □ B.M. 407"	406.59
Rocky Ridge, in front of station; top of rail	400.4
Rocky Ridge, opposite railroad station, in northwest corner of foundation of Robert Biggs's brick house; aluminum tablet stamped "397"	397.138
Loys, railroad crossing at station; top of rail	356.4
Graceham, 450 feet east of station, in top of south end of east abutment to overhead railroad bridge; aluminum tablet stamped "441"	440.659
Graceham, in front of station; top of rail	448.7
Thurmont, 2.1 miles northwest of, on top of south end of west abutment of high bridge 97; chiseled square marked "U.S. □ B.M. 715"	714.52

	Feet.
Thurmont, 2.9 miles northwest of, in top of mud wall at south side of west abutment of steel bridge over Owens Creek; aluminum tablet stamped "779"	779.248
Thurmont, 4 miles northwest of, at west end of switch, south of track, on large rock; chiseled square marked "U.S. □ B.M. 889"	889.16
Deerfield, in front of station; top of rail	959.8
Deerfield, 1.2 miles northwest of, on top of mud wall at south end of west wall of railroad culvert; chiseled square marked "U.S. □ B.M. 1064"	1,063.58
Sabillasville, in southeast corner of front face of St. Marks Lutheran Church; aluminum tablet stamped "1108"	1,107.681
Sabillasville, in front of station; top of rail	1,140.0
Highfield, in front of station; top of rail	1,390.2
Buena Vista Spring, in front of station; top of rail	1,339.9

THURMONT, SOUTH TO CHARLESVILLE.

Thurmont, in front of station; top of rail	517.5
Thurmont, in east face at northeast corner of Thurmont National Bank Building; aluminum tablet stamped "Prim. Trav. Sta. No. 6, 523"	523.080
Thurmont, 2 miles south of, at railroad crossing, 40 feet west of track, on north margin of road, on top of bowlder; chiseled square marked "U.S. □ B.M. 454"	454.17
Catoctin, in front face of stone furnace building, north side of door; aluminum tablet stamped "497"	496.753
Lewistown, in front face at north corner of stone house just south of church; aluminum tablet stamped "402"	402.234
Lewistown, in front of station; top of rail	379.1
Lewistown, 1.1 miles south of, on top of mud wall at east end of south wall of concrete railroad culvert; chiseled square marked "U.S. □ B.M. 403".	403.07

ROCKY RIDGE, NORTH TO EMMITSBURG; THENCE WEST TO SABILLASVILLE.

Motters, in front of station; top of rail	445.2
Motters, in front of station, in southeast corner of foundation of hay scales; aluminum tablet stamped "445"	445.252
Motters, 0.7 mile north of, on top of east side of south wall of cattle pass under railroad; chiseled square marked "U.S. □ B.M. 438"	437.51
Emmitsburg, in front of station; top of rail	416.6
Emmitsburg, in front face of Dutch Reformed Church; aluminum tablet stamped "450"	449.620
Emmitsburg, 1.4 miles west of, 50 feet east of crossroad on north side, schoolhouse at crossroads, on top of large bowlder; chiseled square marked "U.S. □ B.M. 442"	441.66
Emmitsburg, 2.3 miles west of, 280 feet west of brick house, south side of road, on large bowlder; chiseled square marked "U.S. □ B.M. 643"	642.86
Emmitsburg, 4.5 miles west of, 10 feet north of road, on top of large rock; chiseled square marked "U.S. □ B.M. 1176"	1,175.29
Emmitsburg, 5.3 miles west of, in northeast corner of stone foundation of William Miller's house; aluminum tablet stamped "1150 MD"	1,149.583
Emmitsburg, 5.5 miles west of, in forks of road, on top of small bowlder; chiseled square marked "U.S. □ B.M. 1082"	1,081.97
Emmitsburg, 6 miles west of, north of road, on top of large bowlder; chiseled square marked "U.S. □ B.M. 1008"	1,007.64
Emmitsburg, 7.1 miles west of, north of road, 900 feet west of stream, halfway up hill, on top of large bowlder; chiseled circle marked "U.S. ⊙ B.M. 1041"	1,040.67

HAGERSTOWN QUADRANGLE.

BUENA VISTA SPRING, WEST ALONG WESTERN MARYLAND RAILROAD, TO HAGERSTOWN.

	Feet.
Lake Royer, 0.3 mile west of Buena Vista Spring; surface of water May 22, 1908	1,313.1
Pen Mar, 175 feet east of, 10 feet south of track opposite store, on top of large bowlder; chiseled square marked "U.S.□B.M. 1248"	1,247.44
Pen Mar, in front of station; top of rail	1,244.4
Blue Mountain, in front of station; top of rail	1,178.0
Blue Mountain, in northwest corner of brick railroad station; aluminum tablet stamped "1189 MD"	1,188.873
Blue Mountain, 1 mile west of, 40 feet south of track, on top of large bowlder; chiseled square marked "U.S.□B.M. 1106"	1,106.33
Blue Mountain, 2.1 miles west of, 6 feet south of track, on top of large bowlder; chiseled square marked "U.S.□B.M. 1025"	1,025.12
Edgemont, in front of station; top of rail	965.5
Edgemont, 225 feet west of station, 40 feet south of track, in north foundation wall of Bachtell's store and post-office; aluminum tablet stamped "961 MD"	960.388
Smithsburg, in front of station; top of rail	798.2
Smithsburg, 150 feet west of station, in southeast corner of Western Maryland Railroad brick warehouse; aluminum tablet stamped "800 MD"	799.819
Cavetown, in front of station; top of rail	751.3
Cavetown, 1 mile west of, 15 feet east of whistle post, 8 feet south of track, on top of large bowlder; chiseled square marked "U.S.□B.M. 697"	697.26
Cavetown, 1.7 miles west of, 8 feet south of track, 400 feet west of milepost 80, on rock in bank; chiseled square marked "U.S.□B.M. 651"	651.19
Chewsville, in front of station; top of rail	632.9
Chewsville, in north face at northwest corner of brick railroad station building; aluminum tablet stamped "636 MD"	635.774
Chewsville, 1.1 miles west of, 300 feet east of overhead road bridge, 4 feet north of track, on top of large bowlder; chiseled square marked "G.S. □B.M. 580"	579.38
Security, in front of station; top of rail	510.4
Security, 0.3 mile west of, south of track, in top of east back wall of bridge over Marsh Run; aluminum tablet stamped "508 MD"	507.807
Bissell, in front of station; top of rail	510.8
Potomac avenue, in front of station; top of rail	564.5
North Junction, main line Western Maryland Railroad and northbound track of Altenwald cut-off, at frog point; top of rail	589.6
North Junction, intersection of the Cumberland Valley and the Western Maryland railroads; top of rail	590.5
Hagerstown, corner Washington and Jonathan streets, on Jonathan street side of court-house; water table (Coast and Geodetic Survey bench mark 18; old elevation obtained from office)	552.294

EDGEMONT, NORTH ALONG WESTERN MARYLAND RAILROAD, TO MIDVALE.

Shockeys, in front of sign; top of rail	778.5

SMITHSBURG, SOUTH TO MYERSVILLE; THENCE NORTHWEST TO HAGERSTOWN.

Smithsburg, 2.5 miles south of, on top of Blue Mountain, in northwest corner of roads opposite a 2-story frame house, on top of large rock; chiseled square marked "G.S.□B.M. 1512"	1,511.32

	Feet.
Smithsburg, 3.5 miles south of, 150 feet west of road, in southeast corner of east face of stone foundation of frame schoolhouse; aluminum tablet stamped "1335 MD"	1,334.333
Smithsburg, 4.6 miles south of, east of road, 50 feet north of 2-story stone house, on top of bowlder; chiseled square marked "G.S. □ B.M. 1117"	1,116.70
Smithsburg, 5.6 miles south of, west of road, 20 feet south of wooden bridge over stream, on top of flat rock; chiseled square marked "G.S. □ B.M. 1035"	1,034.44
Wolfsville, at crossroads in center of, in northwest corner of roads opposite J. M. Woolf's house, in face of large curb stone; aluminum tablet stamped "1044 MD"	1,043.748
Wolfsville, 1.2 miles southeast of, west of road, 150 feet south of road forks, on top of large bowlder; chiseled square marked "G.S. □ B.M. 931"	930.78
Middlepoint, 0.6 mile south of, west of road, in V of private road, on top of large flat rock; chiseled square marked "G.S. □ B.M. 814"	813.92
Middlepoint, 1.6 miles south of, under corner stone in southwest corner of south face of Grossnickles (Dunkard) Church; aluminum tablet stamped "740 MD"	739.409
Middlepoint, 2.9 miles south of, under northeast corner of iron bridge over Catoctin Creek; chiseled square marked "G.S. □ B.M. 663"	662.57
Ellerton, 1.4 miles south of, west of road, in east side of stone foundation of Tilman Grossnickle's spring house; aluminum tablet stamped "582 MD".	581.398
Myersville, 1.9 miles north of, on west end of north abutment of small wooden trestle over hollow; chiseled square marked "G.S. □ B.M. 970"	969.86
Wolfsville Crossing, at railroad crossing; top of rail	1,020.6
Wolfsville Crossing, 0.2 mile north of, 80 feet west of railroad, on line with second-story windows in east side of John M. Fey's brick house; aluminum tablet stamped "1085 MD"	1,084.555
Wolfsville Crossing, 2.5 miles north of, 5 feet east of trolley track, 390 feet south of railroad crossing, on top of large rock; chiseled square marked "G.S. □ 835B.M."	834.91
Wolfsville Crossing, 3.1 miles north of, in north end of east face of Hagerstown and Myersville Railroad Company's brick power house; aluminum tablet stamped "640 MD"	639.503
Smoketown, at railroad crossing; top of rail	601.9
Wagners Crossroads, in front of station; top of rail	518.3
West Beaver, railroad crossing at south end of station; top of rail	494.0
West Beaver Creek, iron bridge over Beaver Creek, north brace of bridge, west end of rivet on top; chiseled square marked "G.S. □ B.M. 480"	479.95
West Beaver Creek, 1.2 miles north of, at crossroads, in north end of west face of brick schoolhouse on east side of road; aluminum tablet stamped "546 MD"	545.996
Funkstown, at north end of, in north end of east brick wall of Red Man hall; aluminum tablet stamped "479 MD"	479.097

HAGERSTOWN, SOUTH TO ST. JAMES.

Hagerstown, 3.1 miles south of, 10 feet east of railroad, in northwest corner of large rock in bank; chiseled square marked "G.S. □ B.M. 548"	547.84
Hagerstown, 3.7 miles south of, 450 feet east of railroad, in west end of south face of Marsh Church, 2 feet above ground; aluminum tablet stamped "534 MD"	533.592
Hagerstown, 5.3 miles south of, 10 feet west of railroad and opposite school buildings, on large rock in bank; chiseled square marked "G.S. □ B.M. 487"	487.11

HAGERSTOWN, SOUTHWEST 2 MILES ALONG CUMBERLAND VALLEY RAILROAD (UNCHECKED SPUR LINE).

	Feet.
Hagerstown, Cumberland Valley Railroad, in front of station; top of rail	573.5
Hagerstown, 0.6 mile west of, at railroad bridge 74; top of rail (Western Maryland Railroad 554.6)	575.6
Hagerstown, 1 mile west of, 300 feet west of water tank, south of railroad, on top of rock in bank; chiseled square marked "G.S.□B.M. 591"	590.990

WILLIAMSPORT QUADRANGLE.

ST. JAMES SCHOOL, SOUTH TO GRIMES.

St. James, in front of station; top of rail	469.4
St. James, opposite station, 50 feet from track, under porch of two-story frame cottage; aluminum tablet stamped "473 MD"	472.955
St. James, 0.9 mile south of, on northeast corner of south bridge seat of railroad bridge 717; chiseled square marked "G.S.□B.M. 431"	431.05
Spielman, in front of station; top of rail	408.4
Spielman, 0.2 mile south of, railroad bridge 712, on northeast corner of south bridge seat; chiseled square marked "G.S.□B.M. 404"	403.69
Grimes, in front of sign; top of rail	387.0
Grimes, 0.4 mile south of, railroad bridge 705, in west end of north bridge seat; aluminum tablet stamped "391 MD"	390.868

HAGERSTOWN, SOUTHWEST ALONG CUMBERLAND VALLEY RAILROAD, TO POTOMAC RIVER BRIDGE.

Hagerstown, 3.3 miles west of, 15 feet north of track, on top of large rock north of railroad; chiseled square marked "G.S.□B.M. 548"	547.700
Halfway, 150 feet west of railroad, in southwest corner of front face of R. P. Beckley's concrete store on Williamsport pike; aluminum tablet stamped, "539 MD"	539.024
Halfway, in front of station; top of rail	543.0
Halfway, 0.6 mile southwest of, 15 feet from track, on top of rock on north side of cut between milepost 78 and semaphore; chiseled square marked "G.S.□B.M. 525"	524.970
Halfway, 1.7 miles southwest of, 325 feet west of milepost 79, on top of large rock in north bank of cut; chiseled square marked "G.S.□B.M. 487"	487.419
Halfway, 2.9 miles southwest of, in center of south head wall of concrete box culvert under railroad between county road and railroad; aluminum tablet stamped "447 MD"	446.901
Williamsport station, in front of; top of rail	455.2
Williamsport, 0.4 mile southwest of, north of railroad, about 300 feet west of milepost 81, on top of large rock in bank of cut; chiseled square marked "G.S.□B.M. 436"	436.26
Williamsport, 1.3 miles southwest of, on south end of east abutment of back wall of Cumberland Valley Railroad bridge 82-1; chiseled square marked "G.S.□B.M. 382"	382.004

Accident, Flintstone, Frostburg, Grantsville, Hancock, Oakland, Pawpaw, and Piedmont quadrangles.

ALLEGANY, GARRETT, AND WASHINGTON COUNTIES.

The elevations in the following list were determined by primary leveling extended from various bench marks of the Coast and Geodetic Survey transcontinental line.

The leveling in Frostburg and Flintstone quadrangles was done mostly in 1897 by Hargraves Wood; that in Grantsville, Oakland, Accident, and part of that in Pawpaw and Hancock quadrangles was done in 1898 by C. B. Bailey and Hargraves Wood; and the remainder of the work in Pawpaw and Hancock quadrangles was done in 1899 by C. M. Smith.

HANCOCK QUADRANGLE.

HANCOCK, WEST ALONG BALTIMORE PIKE, TO GREEN RIDGE.

	Feet.
Hancock, on coping stone at middle of north wall of Chesapeake and Ohio Canal aqueduct, about 600 feet east of bridge; Coast and Geodetic Survey bench mark stamped "1878 F"	421.004
Hancock, 5.15 miles west of, 0.25 mile east of Harveys, 100 feet west of road to Woodmont, south of pike, in solid rock; bronze tablet stamped "946 C".	945.743

LOCK 50, WEST TO CLEAR SPRING; THENCE NORTH TO SYLVAN,[a] PA. (DOUBLE TARGETED SPUR LINE).

Lock 50, Chesapeake and Ohio Canal, close to watch house, on west end of north side; cut in top stone	404.522
Lock 50, Chesapeake and Ohio Canal, northeast wing; aluminum tablet stamped "402 C"	402.525
Cherry Run, W. Va., 1.5 miles north and 0.75 mile west of, in south side of southwest corner of wing wall of Chesapeake and Ohio Canal viaduct over Licking Creek, 4 feet from west end of wall, about 2 feet below coping, in second tier of masonry under coping; aluminum tablet stamped "MARYLAND 402 C"	402.085

PAWPAW QUADRANGLE.

PRATT, ALONG HIGHWAYS, TO LITTLE ORLEANS.

Green Ridge, south of pike, west of road to Little Orleans, in small ledge of rock at top of ridge; bronze tablet stamped "1204 C"	1,204.237
Little Orleans, north end of east coping of Chesapeake and Ohio Canal aqueduct over Fifteenmile Creek; bronze tablet stamped "459 C"	459.602
Little Orleans, square cut in coping stone of aqueduct over Fifteenmile Creek (Coast and Geodetic Survey bench mark XIII)	460.023

FLINTSTONE QUADRANGLE.

CUMBERLAND, ALONG OLD NATIONAL PIKE, TO PRATT.

Six-mile House; copper bolt in northeast corner of foundation, stamped "881 C"	881.961
Flintstone, Doctor Robinson's house, northwest corner of foundation; bronze tablet stamped "828 C"	828.833
Flintstone, 2.75 miles east of, opposite telegraph pole, top of Polish Mountain; stone stamped "1381"	1,382.38
Pratt, 0.25 mile east of former post-office, 150 feet west of Robinett's old house, south of road, in ledge of rock; aluminum tablet stamped "938 C".	938.67

FLINTSTONE, SOUTH ALONG OLDTOWN ROAD, TO OLDTOWN.

Flintstone, sixth crossing of Town Creek from, 2 feet above grade of creek; copper bolt in ledge west of road to Oldtown, about 0.06 mile northeast of L. T. Shryock's, stamped "666 C"	666.846

---

[a] For elevation on this line north of Maryland boundary see Bull. U. S. Geol. Survey No. 288, 1906, p. 30.

LOCK 67, WEST ALONG CHESAPEAKE AND OHIO CANAL, TO CUMBERLAND.

	Feet.
Lock 67, Chesapeake and Ohio Canal; coping stone (Coast and Geodetic Survey bench mark "XV")	540. 794
Oldtown, 15 feet east of west end of Lock 70; copper bolt in coping stone of south wall, stamped "564 C"	564. 618

FROSTBURG QUADRANGLE.

CUMBERLAND, NORTH AND WEST ALONG CUMBERLAND AND PENNSYLVANIA RAILROAD VIA MOUNT SAVAGE, TO FROSTBURG.

Cumberland, coping of feed lock of canal; Coast and Geodetic Survey bench mark stamped "I.B.M.U.S.C.& G.S. 1878"	624. 231
Cumberland, northeast corner of court-house, in top of stonework; bronze tablet stamped "688 C"	688. 257
Mount Savage, 1,000 feet east of station, in southwest abutment of high bridge over Sulphur Creek; copper bolt stamped "1198 C"	1, 198. 508
Frostburg, 50 feet east of tunnel, on Cumberland and Pennsylvania Railroad, in south side of rock cut; bronze tablet stamped "1929 C"	1, 929. 178

FROSTBURG, SOUTH AND EAST ALONG CUMBERLAND AND PENNSYLVANIA RAILROAD, TO CUMBERLAND.

Vale Summit, 250 feet west of station and 100 feet south of Georges Creek and Cumberland Railroad; copper bolt in large bowlder, stamped "1993 C"	1, 993. 573
Clarysville; platform at station	1, 638. 0
Park station (Casino); Georges Creek and Cumberland Railroad platform	757. 3

GRANTSVILLE QUADRANGLE.

FROSTBURG, VIA PINEY GROVE, NEW GERMANY, AND CRABTREE, TO BLOOMINGTON.

Piney Grove, 0.5 mile east of, near east corner of large house north of pike, 200 feet west of Twomile Run; bronze tablet stamped "2424 C"	2, 424. 545
New Germany, 0.1 mile east of, 100 feet east of Poplar Lick Run, 20 feet south of road to Oakland at intersection of road to old mill, in ledge of rock; bronze tablet stamped "2472 C"	2, 472. 163
New Germany, 8 miles south of, Savage River at mouth of Bear Pen Run, 0.15 mile west of, at edge of clearing, north side of road down Bear Pen Run, in ledge of rock; bronze tablet[a] stamped "1578 C"	1, 578. 174
Floyd, 0.12 mile east of railroad station (known as Frankville), 0.09 mile west of milepost "214 to Baltimore," south of Baltimore and Ohio Railroad, at east end of frame house, in large rock; bronze tablet stamped "1693"	1, 693. 411
Floyd, 2.6 miles east of, 100 feet east of signal at station, south of Baltimore and Ohio Railroad, bench mark in Laffey Rock; bronze tablet stamped "1380 C"	1, 380. 688

PINEY GROVE, WEST VIA GRANTSVILLE, TO KEYSER.

Grantsville, Farmers' Hotel, in southeast corner stone, opposite milepost "14 mi. to Frostburg" and "106 mi. to Wheeling;" aluminum tablet stamped "2299 C"	2, 299. 825
Keyser, northeast corner of stone foundation wall of former post-office building; bronze tablet stamped "2879 C"	2, 880. 585

---

[a] Reported destroyed December 14, 1907.

PIEDMONT QUADRANGLE.

AT BLOOMINGTON.

	Feet.
Bloomington, on top step at northwest corner of Baltimore and Ohio Railroad bridge over Potomac River; Coast and Geodetic Survey bench mark "X X"	1,008. 977

ACCIDENT QUADRANGLE.

NEW GERMANY, SOUTHWEST VIA MEADOW MOUNTAIN ROAD, TO THAYERVILLE.

Thayerville, 5.8 miles east of, north of Meadow Mountain road, near Meadow Mountain Run, in rock 500 feet northeast of old sawmill site; bronze tablet stamped "2573"	2,573. 996

THAYERVILLE, NORTH VIA M'HENRY, HOYES, AND ACCIDENT, TO KEYSER.

Hoyes, southeast corner of foundation wall of Catholic Church; aluminum tablet stamped "2611 C"	2,612. 308
Accident, in northeast corner of foundation of English Lutheran Church; aluminum tablet stamped "2394 C"	2,395. 491

M'HENRY, VIA SANG RUN, FRIENDSVILLE, AND SHELBYSPORT, TO SOMERFIELD, PA.; THENCE SOUTHEAST TO KEYSER.

Friendsville, southeast corner of First avenue and Maple streets, in east foundation wall of building owned by L. E. Friend; aluminum tablet stamped "1501 C"	1,501. 530
Sang Run, in abutment of bridge over Youghiogheny River; bronze tablet stamped "1989 C"	1,988. 899
Oakton, Pennsylvania-Maryland boundary; base of monument	2,362. 86

OAKLAND QUADRANGLE.

OAKLAND, NORTHEAST TO THAYERVILLE.

Oakland, 1.25 miles west of, top of southwest abutment of Baltimore and Ohio Railroad bridge over Youghiogheny River; U. S. Coast and Geodetic Survey bench mark	2,376. 009
Oakland; copper bolt on top of south meridian stone in court-house, stamped "2461 C"	2,460. 859
Oakland, southwest corner stone of court-house; aluminum tablet stamped "2473 C"	2,472. 877

OAKLAND, SOUTH TO REDHOUSE; THENCE EAST TO GORMAN; THENCE NORTH VIA KEARNEY AND DEER PARK, TO MOUNTAIN LAKE.

Redhouse, southwest corner stone of school building; aluminium tablet stamped "2557 C"	2,557. 386
Redhouse, 2.6 miles east of, 4 corners on top of Backbone Mountain, on bowlder 10 feet south of spring; chiseled square	3,073. 93
Gorman, at west end of north abutment of highway bridge over Potomac River; aluminum tablet stamped "2312 C"	2,312. 574
Kearney, 2.2 miles northeast of, 900 feet west of Taskers Corners, 600 feet east-southeast from barn in Jerry Tasker's upper field; aluminum tablet stamped "2720 C"	2,720. 561
Deer Park, between two Baltimore and Ohio stations; 725 feet east of Deer Park Hotel station, surface of southwest wing wall of abutment of stone culvert; aluminum tablet stamped "2447 C"	2,447. 328

	Feet.
Mountain Lake, 3 miles east of Oakland, on top of the southwest corner of west abutment of railroad bridge over Little Youghiogheny River; point marked "B□M" (Coast Survey bench mark XXII)	24,404.813

AT THAYERVILLE.

Thayerville, 700 feet from, south of Meadow Mountain road, 150 feet east of its intersection with Thayerville-Oakland road, in bowlder; bronze tablet stamped "2493 C"	2,493.953

VIRGINIA.

PRECISE LEVELING.

Clarksville, Clifton Forge, Fincastle, Leslie, Lewisburg (30′), Martinsville, Natural Bridge Special, Rocky Mount (30′), and Roanoke (30′) quadrangles.

ALLEGHANY, BOTETOURT, FRANKLIN, HENRY, MECKLENBURG, AND ROANOKE COUNTIES.

The following list embodies the Virginia portion of the results of two lines of precise levels. The first line, a spur, from Durham, N. C., to Clarksville, Va., was run in 1905 by R. L. Libbey. The second line, from Greensboro, N. C., to Lock No. 6, near Charleston, W. Va., was run in three sections: (1) from Greensboro, N. C., to Buchanan, Va., along the Norfolk and Western Railway, in 1905, by R. L. Libbey; (2) from Buchanan to Moss Run, along the Chesapeake and Ohio Railway, in 1906, by N. A. Campbell; and (3) from Moss Run to Lock No. 6, along the Chesapeake and Ohio and the Kanawha and Michigan railways, in 1907, by C. H. Semper.

The closure error of the second line upon the United States Engineer Corps elevation at Lock No. 6, corrected to accord with the 1903 adjustment, was 0.732 foot high; but this error has been removed by adjustment over a total distance of 365 miles.

These lines were leveled independently in both forward and backward directions, broken by temporary bench marks into sections 0.5 mile to 1.5 miles in length. On all sections on which the backward and forward measures differed by more than the allowable limit of error, the forward and backward measures were repeated until a pair run in opposite directions agreed within such limit; and all the other requirements necessary to obtain accurate results were closely adhered to.

The instruments used in 1905 were two self-reading rods, 3.2 meters in length (graduated to centimeters and reading by estimation to millimeters), one Coast and Geodetic Survey precise level, and one large shade umbrella. For the work of 1906 and 1907 rods graduated to yards and decimals were substituted for metric, to facilitate reduction of elevations to feet. These survey parties of each year consisted of 5 persons—2 rodmen, 1 umbrella man, and 1 recorder, under the direction of the levelman in charge.

CLARKSVILLE QUADRANGLE.

SOUDAN, NORTH TO CLARKSVILLE.

	Feet.
Soudan, 125 feet west of south switch of siding, in southeast corner of W. L. Averett's yard; iron post stamped "312" (bench mark U)	311.964
Clarksville, 2.5 miles south of, 60 feet west of Southern Railway tracks, at edge of woods directly opposite milepost 34; iron post stamped "326" (bench mark V)	325.799
Clarksville, 25 feet south of lower station, 5 feet above track, in face of rock cut; aluminum tablet stamped "286" (bench mark W)	286.071
Clarksville, on south side of Main street, between sidewalk and gutter, 125 feet west of tracks; iron post stamped "286" (bench mark X)	285.886
Clarksville, in southeast corner of west abutment pier of Southern Railway bridge; aluminum tablet stamped "288" (bench mark Y)	287.568

MARTINSVILLE QUADRANGLE.

PRICE, N. C., NORTH ALONG NORFOLK AND WESTERN RAILWAY, TO BASSETT.

Ridgeway, in front of station; top of rail	840.8
Ridgeway, 175 feet northeast of station; 85 feet east of railway track, 30 feet east of county road, nearly opposite road-crossing sign; iron post stamped "834"	833.774
Ridgeway, 3.5 miles north of, 200 feet northwest of milepost 54, 600 feet south of mail crane, 50 feet west of railway track; iron post stamped "720"	719.867
Martinsville, in front of station; top of rail	954.2
Martinsville, 350 feet northwest of station, 300 feet north of railway track, 10 feet east of College street, in southwest corner of S. F. Pedigo's yard; iron post stamped "947"	947.268
Martinsville, 2.5 miles northwest of, 60 feet west of Martinsville-Bassett wagon road, 40 feet north of railway track, 600 feet northwest of milepost 62; iron post stamped "773"	772.742
Martinsville, 5.5 miles north of, 660 feet north of milepost 64, in south abutment of concrete railway culvert 1,870; aluminum tablet stamped "729".	729.360
Bassett, 3.5 miles south of, 200 feet south of milepost 66, in west side of first stone culvert, south of milepost 66; square cut	737.061

ROCKY MOUNT (30′) QUADRANGLE.

BASSETT, ALONG NORFOLK AND WESTERN RAILWAY, TO ROCKY MOUNT.

Bassett, in front of station; top of rail	758.6
Bassett, near southeast corner of yard of Jasper Bassett, outside of front fence, 10 feet west of wagon road, 75 feet southwest of road crossing, nearly opposite Bassett furniture factory; iron post stamped "762"	761.566
Town Creek, 200 feet northeast of Philpotts's store, 200 feet southeast of milepost 73, southeast of railroad; iron post stamped "798"	797.387
Town Creek, 0.25 mile north of, 120 feet northwest of railway crossing, in top of southeast wing wall of railway bridge 1860; aluminum tablet stamped "803"	803.198
Henry, 0.5 mile south of, in top of northwest wing wall of concrete railway bridge 1857; aluminum tablet stamped "882"	882.180
Henry, in front of station; top of rail	891.0
Henry, 0.5 mile north of, near end of first curve north of station, 25 feet west of tracks, 200 feet west of river; iron post stamped "905"	904.681
Henry, 3 miles north of, in northwest wing wall of concrete railway bridge 1849, about 500 feet southwest of milepost 81; aluminum tablet stamped "1089"	1,088.913

	Feet.
Ferrum, 200 feet north of H. E. Menifee's store, 100 feet west of railway tracks, in vacant lot owned by H. E. Menifee, 2 feet west of fence and roadway; iron post stamped "1296"	1,296.329
Ferrum, in front of station; top of rail	1,298.1
Ferrum, 2 miles north of, in first masonry culvert north of station, 300 feet northeast of milepost 86; square cut	1,196.334
Waidsboro, 40 feet west of railway tracks, 10 feet north of public road, opposite south switch signal; iron post stamped "1264"	1,263.865
Saunders Siding, 60 feet east of railway track, opposite sign "Water 1 mile," 100 feet northeast of switch, opposite rear of Saunders's store; iron post stamped "1084"	1,084.137
Rocky Mount, midway between the Norfolk and Western and the Southern railways, near crossing, 500 feet southwest of milepost 94, 200 feet southwest of Norfolk and Western station; iron post stamped "1146"	1,145.377
Rocky Mount, in front of station; top of rail	1,146.4

LESLIE QUADRANGLE.

ROCKY MOUNT, ALONG NORFOLK AND WESTERN RAILWAY, TO POINT 4 MILES SOUTH OF ROANOKE.

Rocky Mount, 1.8 miles east of, in southeast wing wall of concrete railway culvert 1828, about 700 feet northeast of sign "1 mile to station;" aluminum tablet stamped "1106"	1,106.274
Wirtz, 1.5 miles south of, 400 feet north of railroad-crossing sign, 20 feet east of track, in first concrete culvert south of milepost 99; aluminum tablet stamped "1067"	1,066.861
Wirtz, 600 feet south of station, 50 feet of railway, 90 feet southeast of A. J. McNeil's store, 10 feet south of wagon road; iron post stamped "1128"	1,127.878
Wirtz, in front of station; top of rail	1,121.3
Boones Mills, 3 miles south of, 700 feet northwest of milepost 103, 503 feet southwest of road, in northwest abutment of trestle 1819; aluminum tablet stamped "1131"	1,130.415
Boones Mills, 60 feet northeast of station; 40 feet south of wagon road, opposite store of C. W. Mills & Co.; iron post stamped "1128"	1,127.915
Wright, 1 mile south of, 500 feet north of milepost 111, in west side of stone culvert; aluminum tablet stamped "1171"	1,170.567
Wright, 800 feet south of station, 500 feet south of milepost 110, 20 feet east of track; iron post stamped "1108"	1,107.700
Starkey, 500 feet north of station, in east side of stone culvert, opposite water tank; square cut	1,138.579
Starkey, in front of station; top of rail	1,138.7
Roanoke, 4 miles south of, 600 feet south of milepost 117, east side of stone culvert; aluminum tablet stamped "1086"	1,085.956

ROANOKE (30′) QUADRANGLE.

POINT 4 MILES SOUTH OF ROANOKE, ALONG NORFOLK AND WESTERN RAILWAY, TO LITHIA.

Roanoke, 1.5 miles south of, in southwest abutment of railway bridge over Roanoke River; aluminum tablet stamped "937"	936.680
Roanoke, in southwest corner of Hotel Roanoke grounds, near Shenandoah avenue and Jefferson street gate, 80 feet north of Jefferson street railway crossing; iron post stamped "924"	923.329
Roanoke, in south abutment of First street viaduct, 270 feet west of Salem avenue, facing railway tracks; aluminum tablet stamped "925"	925.046

	Feet.
Roanoke, in front of station; top of rail	919.7
Hollins, 50 feet east of track, 40 feet southeast of station, near northwest corner of S. V. Nininger's yard; iron post stamped "1169"	1,168.954
Hollins, in front of station; top of rail	1,165.3
Cloverdale, in southwest corner of fenced right of way back of section tool house, 100 feet northwest of station, 10 feet north of wagon road; iron post stamped "1133"	1,132.435
Troutville, 2 miles south of, 500 feet north of milepost 9, in northwest stone abutment of plate-girder bridge; aluminum tablet stamped "1266"	1,265.411
Troutville, in railway right of way opposite and 50 feet west of station, 6 feet west of telegraph pole; iron post stamped "1405"	1,404.598
Troutville, 270 feet north of station, 60 feet north of south switch, in west side of first stone culvert north of station; aluminum tablet stamped "1414"	1,413.973
Troutville, in front of station; top of rail	1,407.7
Nace, 100 feet west of station, on railway right of way, 75 feet southwest of road crossing, 20 feet south of wagon road; iron post stamped "1356"	1,356.034
Nace, 2 miles north of, in southwest wing wall of iron railway bridge 411 over Back Creek; aluminum tablet stamped "1170"	1,169.900
Lithia, in front of station; top of rail	982.0
Lithia, 90 feet west of railway tracks, opposite station, 10 feet south of east of J. W. Shirley's store, near fence corner; iron post stamped "978"	978.058

NATURAL BRIDGE SPECIAL QUADRANGLE.

BUCHANAN, NORTHWEST ALONG CHESAPEAKE AND OHIO RAILWAY, TO SALTPETRE CAVE.

Buchanan, 3 miles south of, 1,000 feet north of milepost 22, near cattle guard, in east side of stone culvert; aluminum tablet stamped "876"	875.355
Buchanan, in front of Norfolk and Western Railway station; top of rail	883.3
Buchanan, near southeast corner of Presbyterian Church on High street; iron post stamped "862"	861.394
Buchanan, in northwest abutment of wagon bridge near Chesapeake and Ohio Railway passenger station; aluminum tablet stamped "832"	831.854
Buchanan, in front of Chesapeake and Ohio Railway station; top of rail	829.8
Buchanan, in northwest abutment of wagon bridge near Chesapeake and Ohio Railway station; aluminum tablet stamped "832"	831.854
Buchanan, in front of station; top of rail	831.1
Buchanan, 3.5 miles west of, at telegraph station; top of rail	849.2
Springwood, on northwest abutment of wagon bridge over James River; aluminum tablet stamped "856"	855.628
Springwood, in front of station; top of rail	851.8
Springwood, 2.3 miles west of, northwest abutment of railroad bridge; aluminum tablet stamped "887"	887.550
Saltpetre Cave, in front of station; top of rail	895.8
Saltpetre Cave, in southeast corner of east abutment at south side of railroad trestle over stream, 100 feet west of station; aluminum tablet stamped "895"	894.888

FINCASTLE QUADRANGLE.

SPRINGWOOD, ALONG CHESAPEAKE AND OHIO RAILWAY, TO GLEN WILTON.

Burketons, in front of telegraph station; top of rail	900.6
Salisbury, in front of station; top of rail	915.4
Salisbury, on northeast abutment of railroad bridge; aluminum tablet stamped "913"	912.569

	Feet.
Eagle Rock, in front of station; top of rail	932.0
Eagle Rock, 0.2 mile west of, on northwest abutment of wagon bridge; aluminum tablet stamped "934"	934.550
Eagle Rock, 0.6 mile west of, road crossing; top of rail	936.1
Eagle Rock, 1.8 miles west of, road crossing; top of rail	939.0
Gala, northwest abutment of railroad bridge; aluminum tablet stamped "954"	954.414
Gala, in front of station; top of rail	955.6
Gala, 1.9 miles west of, on east side of track, 60 feet southeast of switch; iron post stamped "956"	955.872
Haden, in front of station; top of rail	962.3
Haden, 1.4 miles west of, southeast abutment of railroad bridge; aluminum tablet stamped "986"	985.930
Baldwin, in front of station; top of rail	987.1
Baldwin, 0.5 mile west of; road crossing	983.6
Baldwin, 2.2 miles west of, road crossing; top of rail	991.6
Glen Wilton, in front of station; top of rail	999.4
Glen Wilton, 70 feet from northwest end of station, west of private road, 4 feet from fence corner; iron post stamped "997"	996.251

CLIFTON FORGE QUADRANGLE.

LICK RUN, ALONG CHESAPEAKE AND OHIO RAILWAY, TO COVINGTON.

Lick Run, in front of station; top of rail	1,003.8
Lick Run, 0.6 mile west of, rock cut; aluminum tablet stamped "1017"	1,016.584
Lick Run, 1.1 miles west of, road crossing; top of rail	1,026.3
Lick Run, 1.5 miles west of, Alleghany-Botetourt county line; top of rail	1,025.54
Iron Gate, in front of station; top of rail	1,028.7
Iron Gate, 0.3 mile west of, road crossing; top of rail	1,030.9
Clifton Forge, on railway bridge east of station, abutment; aluminum tablet stamped "1064"	1,063.419
Clifton Forge, in front of station; top of rail	1,065.7
Clifton Forge, 3.3 miles west of, road crossing; top of rail	1,127.2
Clifton Forge, 3.3 miles west of, culvert; aluminum tablet stamped "1127"	1,126.680
Lowmoor, in front of station; top of rail	1,145.8
Lowmoor, 2.9 miles west of, south of track, in rock ledge; aluminum tablet stamped "1198"	1,197.163
Lowmoor, 5.1 miles west of, in east abutment of railway bridge over river; aluminum tablet stamped "1198"	1,197.547
Mallow, in front of station; top of rail	1,216.2
Mallow, 2. 1 miles west of, road crossing; top of rail	1,263.6
Mallow, 3 miles west of, road crossing; top of rail	1,246.5
Covington, in front of station; top of rail	1,252.5
Covington, 0.4 mile west of; road crossing	1,255.2
Covington, 0.6 mile west of, in abutment of iron railway bridge over river; aluminum tablet stamped "1255"	1,255.074

LEWISBURG (30′) QUADRANGLE.

COVINGTON, ALONG CHESAPEAKE AND OHIO RAILWAY, TO ALLEGHANY.

Covington, 2.8 miles west of, on northwest abutment of railway bridge over river; aluminum tablet stamped "1304"	1,303.896
Covington, 4.8 miles west of, in bridge abutment; aluminum tablet stamped "1379"	1,378.768

	Feet.
Callaghan, in front of station; top of rail	1,425.9
Moss Run, in front of station; top of rail	1,575.2
Moss Run, 0.9 mile west of, 396 feet west of milepost "Ft. M. 299," south side of track, in face of wall in rock cut; aluminum tablet stamped "1599"	1,598.815
Backbone, in front of station; top of rail	1,729.6
Backbone, 380 feet west of, southeast foundation stone of water tank, north side of track; aluminum tablet stamped "1733"	1,733.079
Jerrys Run, in face of rock at rear of east end of station; aluminum tablet stamped "1910"	1,909.246
Jerrys Run, in front of station; top of rail	1,906.1
East Alleghany, in front of station; top of rail	2,039.7
Alleghany, 350 feet east of station, north face of east abutment of bridge under track; aluminum tablet stamped "2049"	2,047.420
Alleghany, in front of station; top of rail	2,070.6

PRIMARY LEVELING.

Guilford and Snow Hill quadrangles.

ACCOMAC COUNTY.

The elevations in the following list, based on tidal observations made by the Coast and Geodetic Survey at Franklin City, form part of a net of levels carried from Baltimore. (See Maryland list.) The leveling was done in 1900 by J. W. Hodges.

GUILFORD QUADRANGLE.

POCOMOKE CITY, SOUTH TO MASSEY.

	Feet.
Massey, at New Church station of the New York, Philadelphia, and Norfolk Railroad; iron post stamped "24 BALTO"[a]	23.751

SNOW HILL QUADRANGLE.

AT FRANKLIN CITY.

Franklin City, in front of post-office building, in foundation wall; bronze tablet stamped "4 BALTI"	3.415

Hampton, Isle of Wight, Jamestown, Toano, Williamsburg, and Yorktown quadrangles.

GLOUCESTER, ISLE OF WIGHT, JAMES CITY, SURREY, WARWICK, AND YORK COUNTIES.

The elevations in the following list are based on the latest adjusted heights along the Coast and Geodetic Survey precise-level line from Newport News. In crossing the James and York rivers, synchronous gage records were made for rising and falling tides.

The leveling in Toano, Williamsburg, Yorktown, and Jamestown, quadrangles was done in 1904 by T. A. Green; in Hampton quadrangle in 1906 by R. S. Deemer.

TOANO QUADRANGLE.

AT CROAKER.

	Feet.
Croaker, 25 feet east of road forks, directly south of post-office and store kept by K. K. Tyssen; iron post stamped "107 ADJ 1903"	107.360

---

[a] Upper part was broken off accidentally in 1909.

WILLIAMSBURG QUADRANGLE.

WILLIAMSBURG, NORTH ALONG HIGHWAY, TO CROAKER: THENCE NORTHEAST, CROSSING YORK RIVER, TO SIGNPINE; THENCE SOUTHEAST VIA SASSAFRAS TO GLOUCESTER; THENCE SOUTH TO GLOUCESTER POINT.

	Feet.
Williamsburg, in east side of post-office, in fourth brick from northeast corner; aluminum tablet stamped "84 ADJ 1903"	84.524
Williamsburg, 4.8 miles north of, at main road forks 1.3 miles west of Magruder post-office, just south of road forks on east side of road, at edge of Mr. Crest's farm; iron post stamped "82 ADJ 1903"	81.969
Oaktree, 2.1 miles northwest of, junction with main road, 1.4 miles northeast of Lightfoot, east side of road, just south of forks, on edge of William Maboul's farm; iron post stamped "115 ADJ 1903"	115.034
Croaker, 3.6 miles northeast of, south of York River, 0.2 mile north of mouth of Taskinas Creek, on ground of the Wilburg H. Davis estate, post is planted near southeast corner of kitchen of residence, on south side; iron post stamped "39 ADJ 1903"	38.602
West End, north of York River, west of road, 300 feet west of small creek, on Captain Coleman's estate, 75 feet south of house occupied by Moses Roe; iron post stamped "3 ADJ 1903	3.431
Signpine, 1.1 miles south of crossroads, west of oak tree standing in road; iron post stamped "92 ADJ 1903"	92.272
Sassafras post-office, at southwest corner of crossroads, at northeast corner of north side B. C. Newcomb's store; iron post stamped "97 ADJ 1903"	97.174
Gloucester, in fifth brick from northwest corner at west side of building owned and occupied by L. E. Mumford Banking Co., in tenth course of bricks above ground; aluminum tablet stamped "76 ADJ 1903"	76.155
Whitemarsh post-office, west of road, at junction with road running west, just north of forks, in southeast corner of J. R. Newcomb's store; iron post stamped "55 ADJ 1903"	54.966
Ordinary post-office, 1 mile south of west of road, near southeast corner of W. H. Hoggs's store; iron post stamped "39 ADJ 1904"	39.586

YORKTOWN QUADRANGLE.

GLOUCESTER POINT, ACROSS YORK RIVER, TO YORKTOWN; THENCE SOUTHEAST, TO LEE HALL.

Gloucester Point post-office, at south side, near southwest corner of store kept by J. A. Taliaferro; iron post stamped "5 ADJ 1903"	4.881
Yorktown post-office, 300 feet west of boat wharf, west of road, at corner of lot owned by R. W. Shields; iron post stamped "6 ADJ 1903"	6.442
Halsteads Point, 1.1 miles south of, east side of Lebanon Church, in third brick from northeast corner, in tenth course of bricks above ground; aluminum tablet stamped "82 ADJ 1903"	81.845

WILLIAMSBURG, SOUTHEAST ALONG CHESAPEAKE AND OHIO RAILWAY, TO DENBIGH.

Grove, on south side of post-office, near southeast corner; iron post stamped "89 ADJ 1903"	89.157
Lee Hall, 1.9 miles southeast of, pumping station at reservoir, on east side of pump house, in south end of large stone forming doorsill of front entry; aluminum tablet stamped "25 ADJ 1903"	25.281
Denbigh, in fifth brick from northeast corner (east side) of brick courthouse, in tenth course of bricks above ground; aluminum tablet stamped "36 ADJ 1903"	36.193

SPRINGFIELD, NORTHWEST, VIA SEPTA AND BACONS CASTLE,[a] TO HIGHGATE.

	Feet.
Septa, just southeast of road forks, on west side near south corner of post-office and store kept by J. H. Edward; iron post stamped "86 ADJ 1903"	86.852
Septa, 3 miles northwest of, just south of Moonlight crossroads, west of road, on lot owned by W. L. Ward; iron post stamped "84 ADJ 1903"	85.044
Septa, 5.3 miles northwest of, at junction with second-class road east, just south of forks, at northwest corner of lot owned by J. G. Goodrich, 25 feet southeast of Ferguson Grove Baptist Church; iron post stamped "92 ADJ 1903"	92.386
Bacons Castle, just south of crossroads on east side of road, near southwest corner of store and post-office; iron post stamped "84 ADJ 1903"	83.407
Highgate, at store and post-office at main forks of road; iron post stamped "75 ADJ 1903"	74.194

ISLE OF WIGHT QUADRANGLE.

NEWPORT NEWS, WEST ACROSS JAMES RIVER, TO BATTERY PARK; THENCE WEST TO SPRINGFIELD.

Battery Park, 25 feet south of boat wharf, at northwest corner (north side) of J. G. Wilson's store; iron post stamped "5 ADJ 1903"	5.776
Smithfield, in west side (second brick from north) of store owned by T. J. Cox, in seventeenth course of bricks above ground; bronze tablet stamped "Prim. Trav. Sta. No. 209–A 12"	13.064

JAMESTOWN QUADRANGLE.

HIGHGATE, NORTHWEST TO SCOTLAND; THENCE ACROSS JAMES RIVER TO JAMESTOWN; THENCE NORTHEAST TO WILLIAMSBURG.

Highgate, 2.2 miles northwest of, north of road just east of main forks, at southeast corner of store; iron post stamped "74 ADJ 1903"	73.729
Scotland, at southeast corner east side of store kept by Mrs. W. E. Adams; iron post stamped "7 ADJ 1903"	6.811
Jamestown, on land owned by the Association for the Preservation of Virginia Antiquities, at northwest corner of barn, on old church grounds; iron post stamped "9 ADJ 1903"	8.156

HAMPTON QUADRANGLE.

YORKTOWN, SOUTHEAST TO NEAR NORTH NEWPORT NEWS. (MEAN OF DIRECT AND REVERSE LINES.)

Yorktown, 3.1 miles southeast of, on Hampton-Yorktown road, at northwest corner of road southwest, 0.8 mile northwest of Harris Grove; iron post stamped "65"	64.418
Grafton, 0.4 mile northeast of, south of Hampton-Yorktown road, 300 feet north of wood line; iron post stamped "56"	55.573
Kings Corners, 0.4 mile northeast of, 0.2 mile southwest of Zion Church (colored); iron post stamped "36"	35.961
Moores Place, 0.1 mile southwest of, 0.4 mile east of Negro Bethel Church, east of Hampton-Yorktown road; iron post stamped "31"	30.786
Little Bethel Church, on Yorktown-Hampton road, 5.5 miles northeast of Hampton; iron post stamped "20"	19.96

---

[a] An error of 1 foot between Battery Park and Scotland was adjusted arbitrarily by placing it south of Bacons Castle.

NEAR NORTH NEWPORT NEWS, TO NEWPORT NEWS.

	Feet.
Newport News, 3.99 miles north of, road crossing Chesapeake and Ohio railway, southwest corner; iron post stamped "30"[a]	29.441

POINT 6 MILES NORTH OF NEWPORT NEWS, SOUTHEAST VIA HAMPTON, TO OLD POINT COMFORT.

Hampton, 2 miles west of, on Hampton-Yorktown road, center of triangle (Newmarket Corners); iron post stamped "11"[b]	11.347

Appomattox (30′), Boydton, Callands, Chatham, Clarksville, Clover, Leslie, Lynchburg (30′), Moneta, Nathalie, and Virgilina quadrangles.

CAMPBELL, CHARLOTTE, HALIFAX, MECKLENBURG, AND PITTSYLVANIA COUNTIES.

The elevations in the following list result mainly from a line of levels run in 1905 by A. H. Horton, of the water-resources branch, from a bench mark at Clarksville established by the precise-level party of R. L. Libby. The line follows Roanoke River (approximately) from Clarksville to Hurt; thence the railroad via Elba to Rocky Mount, where it is connected with a bench mark also established by Mr. Libby. A spur line extends 14 miles down Roanoke River from Clarksville, and another line extends from Toshes to Deerwood Ford.

Additional work was done in 1908 by E. O. Halbert, in cooperation with the State, in Clarksville, Clover, Nathalie, and Virgilina quadrangles, based on bench marks at Clarksville, Randolph, and Clarkton.

CLARKSVILLE QUADRANGLE.[c]

CLARKSVILLE, NORTHWEST ALONG ROANOKE RIVER, TO BAILEY'S PLANTATION.

	Feet.
Bluestone Creek, at mouth of, 250 feet north of Roanoke River, 120 feet east of Skipwith's (deserted) mill, top of low embankment; iron post stamped "284 ADJ 1903"	283.550
Abbyville, 1 mile below, in pasture lot of William Russell, 400 feet from river, in top of granite bowlder; aluminum tablet stamped "290 ADJ 1903"	289.683
Abbyville, 2 miles above, on left bank of Roanoke River, at foot of bluff on McLean's plantation, 100 feet north of an old mill, set vertically in a granite ledge; aluminum tablet stamped "296 ADJ 1903"	296.192
Abbyville, 5 miles above, 1,300 feet below mouth of Difficult Creek, which is on right bank of river, set vertically in a rock ledge on Bailey's plantation, on left bank of river; aluminum tablet stamped "312 ADJ 1903"	311.639

CLARKSVILLE, WEST ALONG SOUTHERN RAILWAY, TO POINT 2 MILES WEST OF NELSON.

Clarksville, in southeast corner of west abutment pier at Southern Railway bridge; aluminum tablet stamped "288"	287.568
Clarksville Junction, in front of station; top of rail	287.8
Clarksville Junction, 200 feet west of, at railroad bridge; top of rail	292.6
South Clarksville, in front of station; top of rail	357.7

---

[a] Not adjusted; closure on Coast and Geodetic Survey bench mark —0.496 foot.

[b] Not adjusted; closure on Coast and Geodetic Survey bench mark —0.501 foot.

[c] For precise-level elevations in Clarksville quadrangle see p. 48.

	Feet.
South Clarksville, 3 miles west of, 50 feet north of track, at west end of fill, inside of fence, in base of white-oak tree; spike	338.80
South Clarksville, 1.2 miles west of, east end of small cut, sandstone bowlder 15 feet north of track; top marked "G.S.□376 B.M."	376.20
South Clarksville, 2.2 miles west of, 300 feet north of track, in south face of chimney of George Day's 1½-story log house, 18 inches above ground; aluminum tablet stamped "420"	419.574
South Clarksville, 3.4 miles west of, 50 feet north of track, on public road, in root of large white-oak tree; railroad spike	436.99
Buffalo Junction, in front of station; top of rail	429.8
Buffalo Junction, 1.1 miles west of, 120 feet south of railroad track south of public road, in foot of oak tree; spike	468.04
Buffalo Junction, 2 miles west of, 200 feet south of railroad, in north face of chimney of H. T. Arrington's 1½-story house, 18 inches above ground; aluminum tablet stamped "471"	470.518
Buffalo Junction, 4.8 miles west of, top of brick railroad culvert, south head wall; aluminum tablet stamped "423"	423.408
Nelson, in front of station; top of rail	429.9

CLOVER QUADRANGLE.

DIFFICULT CREEK, NORTHWEST ALONG ROANOKE RIVER, TO CLARKS FERRY.

Lacks Ferry, 2 miles below, right bank of Roanoke River, 125 feet south of large double gum tree and large double white-oak tree, 250 feet from edge of river, 1 foot above line between properties of Alex. M. Coleman and Chas. Wadkins; iron post stamped "315 ADJ 1903"	315.265
Lacks Ferry, 1,100 feet above, on left bank of river, 50 feet from edge of river, in rock ledge; aluminum tablet stamped "323 ADJ 1903"	322.733
Beatrice, about 100 feet from former post-office; iron post stamped "479 ADJ 1903"	479.368
Beatrice, 3.4 miles northwest of, road forks at Black Castle schoolhouse; iron post stamped "489 ADJ 1903"	489.150
Randolph; copper bolt in cement in capstone in left abutment downstream side of Southern Railway bridge across Roanoke River, stamped "341 ADJ 1903"	340.657
Clarks Ferry, 0.8 mile north of, in west side, near southwest corner of foundation of T. C. Watkins's house; aluminum tablet stamped "453 ADJ 1903"	452.562

RANDOLPH, SOUTHWEST ALONG SOUTHERN RAILWAY, TO POINT 1 MILE SOUTHWEST OF CLOVER.

Randolph; copper bolt in capstone in left abutment downstream side of railroad bridge across Roanoke River, stamped "341"	340.657
Randolph, railroad bridge over Roanoke River; top of rail	346.1
Surface of water under bridge over Roanoke River; September 30, 1908	306
Clover, in front of station; top of rail	491.8
Clover, in face of division wall between Bank of Clover and post-office, on west side of Main street; aluminum tablet stamped "506"	505.789

NATHALIE QUADRANGLE.

NEAR WATKINS, NORTHWEST ALONG ROANOKE RIVER, TO CLARKTON.

Watkins, 0.33 mile west of post-office, in southwest corner of four corners; iron post stamped "490 ADJ 1903"	490.106
Watkins, 1.2 miles west of, north of road, 100 feet northeast of I. C. Scott's mail box, corner of a stone post 1 foot above ground	461.74

	Feet.
Noland, north of road, 85 feet east of post-office and store; iron post stamped "503 ADJ 1903"	503.070
Coles Ferry, on hill south of, opposite Mr. Stearn's house, on hill on right bank, in large bowlder embedded in ground; aluminum tablet stamped "401 ADJ 1903"	401.429
Coles Ferry, 3 miles above, on north side of river road, on Bruce's estate near H. C. Gilliland's house; iron post stamped "368 ADJ 1903"	367.973
Clarkton, in grass plot between Clark's store and station; iron post stamped "393 ADJ 1903"	[a] 386.434

HOUSTON, NORTH ALONG NORFOLK AND WESTERN RAILWAY, TO CLARKTON.

Neathery, in front of station; top of rail	495.0
Neathery, 0.2 mile north of, 10 feet west of track, in top of west head wall of small stone railway culvert; aluminum tablet stamped "482"	481.977
Neathery, 3.3 miles north of, 10 feet east of track, in top of east head wall of small stone railway culvert; aluminum tablet stamped "534"	533.801
Crystal Hill, in front of station; top of rail	564.3
Crystal Hill, 1.9 miles north of, 200 feet south of road crossing, 10 feet west of track, in top of west head wall at small railway culvert; aluminum tablet stamped "567"	566.731
Lennig, in front of station; top of rail	576.7
Lennig, 2.3 miles north of, 20 feet west of track, in top of west head wall of small railway culvert; aluminum tablet stamped "531"	530.543
Nathalie, in front of station; top of rail	524.5
Nathalie, 1.8 miles north of, top of west head wall of small railway culvert; aluminum tablet stamped "432"	431.738
Clarkton, in grass plot between Clark's store and station; iron post stamped "393 ADJ 1903"	386.434

SCOTTSBURG, NORTHEAST ALONG SOUTHERN RAILWAY, TO POINT NEAR CLOVER.

Clover, 5 miles south of, 2,100 feet north of overhead bridge, top of west head wall of stone railway culvert; aluminum tablet stamped "375"	374.513
Clover, 2.7 miles south of, top of east catch wall of south abutment of railway bridge; aluminum tablet stamped "363"	362.656

LYNCHBURG (30′) QUADRANGLE.

PERTH, WEST ALONG ROANOKE RIVER, TO HURT.

McKeever Ferry, about 0.3 mile east of road forks, 75 feet south of T. L. Rudder's house, in a 3-foot turkey-oak tree; aluminum tablet stamped "545 ADJ 1903"	545.008
Green Hill, at road forks to ferry; iron post stamped "510 ADJ 1903"	509.961
Cedar Forest, 150 feet east of Mrs. E. Hendrick's store, at corner of fence; iron post stamped "540 ADJ 1903"	539.844
Cedar Forest, 3 miles northwest of, south of road, opposite Blackstock schoolhouse, in a 3-foot oak tree; aluminum tablet stamped "702 ADJ 1903"	701.952
Level Run, 2 miles northeast of, at road forks near J. B. Moses farm; iron post stamped "704 ADJ 1903"	703.894
Level Run, north of road opposite post-office, in a 2-foot oak tree; aluminum tablet stamped "719 ADJ 1903"	718.491
Level Run, 3 miles northwest of, about 200 feet south of Sandy Coleman's house, on Hubbard's plantation, in rock ledge west of road; aluminum tablet stamped "694 ADJ 1903"	694.144

---

[a] The elevation given is corrected for a mistake of 6.814 feet found October, 1908.

	Feet.
Grit, in road in front of A. M. Peak's house, in south side of a 4-foot white-oak tree; aluminum tablet stamped "784 ADJ 1903"	783.978
Grit, 2 miles northwest of, in forks of road at top of hill above mill creek ford; iron post stamped "728 ADJ 1903"	727.702
Hurt, 0.5 mile east of, in a 2½-foot oak at top of hill west of Reed Creek, south of road on Doctor Adams's plantation; aluminum tablet stamped "710 ADJ 1903"	710.330
Hurt, in right abutment (upstream side) of Southern Railway bridge; top of southwest bolt fastening upstream and post seat to abutment	545.489

HURT, SOUTH ALONG SOUTHERN RAILWAY, TO POINT NEAR ELBA.

Hurt, in ground at east post of "Welcome" gate at Hurt's plantation; iron post stamped "559 ADJ 1903"	558.871
Motley, 2 miles north of, on west side of railroad about 30 feet from track, between mileposts 201 and 202, in a 4-foot oak; aluminum tablet stamped "658 ADJ 1903"	658.418
Motley, in ground at G. W. Shuler's store, at east corner; iron post stamped "771 ADJ 1903"	770.529
Sycamore, 0.25 mile south of station, in north side of north chimney of G. W. Ramsey's house; aluminum tablet stamped "751 ADJ 1903"	750.982
Elba, 3 miles north of, on west side of road from Elba to Sycamore, 600 feet south of railroad crossing, on east side of track, directly opposite Walton's mail box; iron post stamped "853 1903"	853.140
Elba, 2 miles north of, east of railroad, near first sign "Station 1 mile" referring to Elba, in a tree; aluminum tablet stamped "864 ADJ 1903"	864.126

CHATHAM QUADRANGLE.

ELBA, WEST ALONG SOUTHERN RAILWAY, TO TOSHES.

Elba, 150 feet north of Mrs. Shelton's store, at southeast corner of Mrs. E. W. Shelton's ground; iron post stamped "844 ADJ 1903"	843.589
Farmers, at northwest corner of E. H. L. Farmer's house, east of railroad, 60 feet from track; iron post stamped "1044 ADJ 1903"	1,044.212
Pittsville, 1 mile east of, in ground at road forks; iron post stamped "965 ADJ 1903"	965.358
Toshes, 1,500 feet east of, in railroad cut east of Toshes, 140 feet west of west end of trestle across Buck Branch, tributary to Fryingpan Creek, south of railroad, at east end of rock ledge; aluminum tablet stamped "681 ADJ 1903"	681.203
Toshes, 125 feet south of post-office and store (property of C. S. Bennett), 25 feet east of scale house, in rock ledge; aluminum tablet stamped "695 ADJ 1903"	695.135

MONETA QUADRANGLE.

TOSHES, ALONG HIGHWAYS TO DEERWOOD FORD (SPUR LINE).

Pig River, 1 mile south of bridge across, south of road, 0.25 mile above Graves's new dam on Pig River, in 4-foot white oak; aluminum tablet stamped "625 ADJ 1903"	624.38
Menla, about 1.5 miles southeast of, directly east of Frank Graves's house, 50 feet below his mail box, in east side of a 3-foot oak tree; aluminum tablet stamped "734 ADJ 1903"	733.79
Menla, in front of J. T. Robinson's house, west of road, on east side of 4-foot oak tree; aluminum tablet stamped "862 ADJ 1903"	861.92

	Feet.
Deerwood Ford, on Roanoke River, in northeast stone chimney of G. L. English's house; aluminum tablet stamped "618 ADJ 1903"	620.87
Deerwood Ford, on sycamore tree on left bank of Roanoke River near transit station 2681+15; Virginia Railway bench mark	601.62

CALLANDS QUADRANGLE.

TOSHES, WEST ALONG SOUTHERN RAILWAY, TO GLADE HILL.

Sandy Level, in quartz ledge near road crossing of Reddies Creek; aluminum tablet stamped "660 ADJ 1903"	659.953
Ajax, 12 feet south of track, 450 feet west of crossing, east side of ledge of rock; aluminum tablet stamped "873 ADJ 1903"	872.937
Penhook, 500 feet west of station, 8 feet south of track, in rock ledge; aluminum tablet stamped "982 ADJ 1903"	981.591
Novelty, in ground at angle of store (former post-office); iron post stamped "1009 ADJ 1903"	1,008.579
Union Hall, in north face of chimney of Dudley & Co. store; aluminum tablet stamped "1006 ADJ 1903"	1,005.357
Glade Hill, 1.5 miles east of, in east side of south chimney of Mrs. Matilda Bird's house, north of track, 350 feet from track; aluminum tablet stamped "1008 ADJ 1903"	1,007.352
Glade Hill, in a 3-foot chestnut oak, 100 feet east of former post-office, 65 feet south of track; aluminum tablet stamped "1070 ADJ 1908"	1,069.611

LESLIE QUADRANGLE.

GLADE HILL, WEST ALONG SOUTHERN RAILWAY, TO ROCKY MOUNT.

Redwood, 2 miles east of, 125 feet north of track on Jas. O. Perdies's farm, 30 feet west of west end of second trestle west of Glade Hill, on left bank of small branch, in lower of two small rock ledges; aluminum tablet stamped "1060 ADJ 1903"	1,059.638
Redwood, in small rock ledge in front of Perdies Brothers' store; aluminum tablet stamped "1178 ADJ 1903"	1,177.906
Redwood, about 0.5 mile west of, 300 feet west of railroad crossing, 30 feet south of track, in east end of a large quartz bowlder north of road; aluminum tablet stamped "1138 ADJ 1903"	1,138.063
Rocky Mount, 2.5 miles east of, 1,200 feet west of milepost 34, 75 feet west of railroad crossing, 9 feet south of center of track; iron post stamped "1193 ADJ 1903"	1,192.841
Rocky Mount, 1.8 miles east of, in southeast wing wall of Norfolk and Western Railway concrete culvert 1828, about 700 feet northeast of sign "1 mile to station;" aluminum tablet stamped "1106 ADJ 1903"	1,106.274

BOYDTON QUADRANGLE.

CLARKSVILLF, EAST 14 MILES DOWN ROANOKE RIVER, TO TAYLORS FERRY (DOUBLE SPUR LINE).

Clarksville, 2.5 miles below, on right bank of river on C. S. Hito's plantation, about 340 feet from bank of river, in granite ledge on left bank of a small ditch; aluminum tablet stamped "273 ADJ 1903"	273.007
Clarksville, 7 miles below, opposite J. T. Lewis's plantation; opposite lower end of Finches Island, in granite ledge projecting from left bank of river; aluminum tablet stamped "250 ADJ 1903"	249.855
Island Creek, 215 feet from right bank, 300 feet from river, in a granite ledge on James Bulloch's plantation; aluminum tablet stamped "259 ADJ 1903"	259.156

	Feet.
Eagle Point, 1,500 feet east of ruins of mill, at foot of slope, 100 feet below Hospital Spring on Doctor Wimbish's plantation, in granite ledge; aluminum tablet stamped "239 ADJ 1903"	239.337

APPOMATTOX (30′) QUADRANGLE.

BROOKNEAL, TO PERTH.

Brookneal, on east side of road to ferry, nearly opposite May's cash store, about 75 feet north of Baptist Church; iron post stamped "564 ADJ 1903"	564.155
Brookneal, on William Scott's plantation, 135 feet northwest of center of road to ferry, 50 feet from low-ground cornfield, about 350 feet north from ferryman's house at ferry, in rock ledge flush with ground; aluminum tablet stamped "388 ADJ 1903"	388.000
Brookneal, 2.3 miles southwest of, about 20 feet from northwest corner of Hickory Road Church, in an 18-inch oak tree; aluminum tablet stamped "599 ADJ 1903"	599.170
Perth, 225 feet northeast of store and former post-office, south of road, on W. H. and J. L. Glass's property; iron post stamped "612 ADJ 1903"	611.907

VIRGILINA QUADRANGLE.

VIRGILINA, WEST ALONG SOUTHERN RAILWAY, TO DENNISTON; THENCE NORTH ALONG NORFOLK AND WESTERN RAILWAY, TO HOUSTON.

Virgilina, in front of station; top of rail	516.1
Christie, in front of station; top of rail	479
Mayo (3.8 miles west of Christie), 300 feet east of station, top of east head wall of concrete railway culvert; aluminum tablet stamped "346"	345.649
Mayo, in front of station; top of rail	344.9
Mayo, 1.9 miles west of, in southwest corner of east abutment of railway bridge over Hyco Creek; aluminum tablet stamped "336"	335.497
Denniston, 50 feet north of Norfolk and Western Railway station, in top of east head wall of small concrete railway culvert; aluminum tablet stamped "409"	409.449
Cluster Springs, 300 feet west of station, in front (brick) wall of Traynham Brothers' store; aluminum tablet stamped "499"	499.446
Cluster Springs, in front of station; top of rail	493.3
Cluster Springs, 3.5 miles north of, 5 feet east of track, in top of head wall of small concrete railway culvert; aluminum tablet stamped "339"	339.249
South Boston, railway bridge over Dan River; top of rail	336.6
Water in Dan River under bridge; surface September 17, 1908	302
South Boston, in northeast corner of north abutment pier at Norfolk and Western Railway bridge over Dan River; aluminum tablet stamped "331"	330.976
South Boston, in front of station; top of rail	334.4
South Boston, 3.4 miles north of, 15 feet east of track, top of east head wall at small stone railway culvert; aluminum tablet stamped "447"	447.153
Houston, in front of station; top of rail	385.6
Houston, 0.7 mile north of, 20 feet west of track, in top of west head wall of small railway culvert; aluminum tablet stamped "381"	380.827

SOUTH BOSTON, NORTHEAST ALONG SOUTHERN RAILWAY, TO SCOTTSBURG.

South Boston, in front of station; top of rail	333.4
Wolftrap, 1.8 miles south of, 800 feet south of milepost 34, in top of southeast corner of east head wall of stone railway culvert; aluminum tablet stamped "318"	318.117

	Feet.
Wolftrap, in front of station; top of rail	359. 2
Scottsburg, 1.7 miles south of, 10 feet west of track, 300 feet north of whistle post, in top of west head wall of small concrete railway culvert; aluminum tablet stamped "331"	331. 421
Scottsburg, in front of station; top of rail	352. 8

Fincastle and Natural Bridge special quadrangles.

BOTETOURT AND ROCKBRIDGE COUNTIES.

The elevations in the following list are based on an aluminum tablet set in the west end of north abutment of wagon bridge over James River at Buchanan, the elevation of which is accepted as 831.854 feet above mean sea level. This elevation was obtained from a line of precise levels run from Greensboro, N. C., to Buchanan in the summer of 1905 by R. L. Libby. The leveling was done in 1905 by T. A. Green.

NATURAL BRIDGE SPECIAL QUADRANGLE.

BUCHANAN, NORTHEAST ALONG CHESAPEAKE AND OHIO RAILWAY, TO GILMORE MILLS.

	Feet.
Buchanan, 3.3 miles northeast of, 200 feet east of house occupied by Charles Stinnett, in ledge of rock; aluminum tablet	818. 701
Dillon, in front of station; top of north rail of main track	813. 9
Indianrock, in southeast corner of west abutment at south side of railway bridge over Whistle Creek; aluminum tablet	794. 164
Indianrock, in front of station; top of north rail of main track	795. 9
Rocky Point, in southeast corner of east abutment of railroad bridge over Roaring Run; aluminum tablet	771. 149
Alpine, in front of station; top of south rail	773. 6
Gilmore Mills, in front of station; top of north rail	751. 1

GILMORE MILLS, NORTH ALONG HIGHWAY, VIA NATURAL BRIDGE AND LONGWOOD, TO MURAT.

Natural Bridge, on north side of bridge, in rock standing in inclosure; aluminum tablet stamped "1150 ADJ 1903"	1, 149. 661
Natural Bridge, 2.6 miles northeast of, at main road forks 1.5 miles southwest of Fancy Hill post-office, in rock north of road just east of forks; aluminum tablet stamped "1231 ADJ 1903"	1, 231. 014
Longwood, 1 mile northeast of, in fifth brick from west at southwest corner (south side) of Seceder Church, in fourth course of bricks above foundation; aluminum tablet stamped "1179 ADJ 1903"	1, 178. 839
Longwood, 3.8 miles northeast of, 75 feet south of stream crossing, in large rock; aluminum tablet stamped "1251 ADJ 1903"	1, 250. 677
Murat, in southeast corner of south abutment of south end of highway bridge over Buffalo Creek; aluminum tablet stamped "1021 ADJ 1903"	1, 021. 262

BUCHANAN, NORTH ALONG HIGHWAYS, VIA RAPPS MILL, TO MURAT.

Buchanan, 3 miles north of, on Mr. Peachin's place, in sandstone 75 feet north of house occupied by Charles Miller; aluminum tablet	1, 161. 841
Buchanan, 7 miles north of, at main road forks just west of Dunkard Church in rock on east side of road just north of forks; aluminum tablet stamped "1597 ADJ 1903"	1, 596. 574
Rapps Mill, 50 feet southeast of, in front yard of James B. Rapp, in sandstone; aluminum tablet stamped "1497 ADJ 1903"	1, 496. 550

	Feet.
Rapps Mill, 3.2 miles northeast of, 210 feet north of main forks, in ledge of rock east of road; aluminum tablet stamped "1277 ADJ 1903"	1,277.262
Murat, 3.5 miles west of, 6.2 miles northeast of Rapps Mill, at iron wagon bridge over South Buffalo Creek, on south side at southeast corner of east abutment; aluminum tablet stamped "1150 ADJ 1903"	1,149.707

UP NORTH BUFFALO CREEK, VIA OAKDALE AND OVER BIGGS MOUNTAIN, TO DAGGER SPRINGS AND GALA.[a]

Oakdale, 1.5 miles southwest of, north of road, in rock 30 feet west of main road forks; aluminum tablet stamped "1307 ADJ 1903"	1,308.004
Oakdale, 6 miles southwest of, at gap at head of North Buffalo and Mill Creek, in large bowlder; aluminum tablet stamped "2179 ADJ 1903"	2,179.680
Oakdale, 9.8 miles southwest of, at crossroads, 2 miles southeast of Dagger Springs, directly north of 4 corners, in rock north of road; aluminum tablet stamped "1392 ADJ 1903"	1,392.463

FINCASTLE QUADRANGLE.

SPRINGWOOD, WEST ALONG HIGHWAY, TO FINCASTLE.

Springwood, 5.1 miles southwest of, on north side at northwest corner of stone foundation of house owned by C. C. Burch; aluminum tablet	1,284.070
Fincastle, 10 feet west of front entrance of court-house, in stone step on south side of building; aluminum tablet	1,256.696
Fincastle, 4.4 miles northwest of, at mouth of Poorhouse Hollow, 650 feet west of main forks, on north side of North Fork of Catawba Creek, east of second-class road; in limestone ledge; aluminum tablet	1,255.379

Middletown, Mount Vernon, and Seneca quadrangles.

LOUDOUN AND FAIRFAX COUNTIES.

The elevations in the following list are based on precise-level lines of the Coast and Geodetic Survey and the Baltimore and Ohio Railroad.

The leveling in Seneca and Mount Vernon quadrangles was done in 1906 by R. A. Farmer; and in Middletown quadrangle in 1907 by W. R. Winstead.

Elevations in Maryland appear on pages 34 and 35; those in West Virginia have been published in Bulletin 399.

MIDDLETOWN QUADRANGLE.

POINT OF ROCKS, SOUTHWEST ALONG HIGHWAY, TO TAYLORSTOWN; THENCE NORTHWEST TO HARPERS FERRY.

	Feet.
Taylorstown, 0.1 mile west of post-office, in center of south end of pillar at west end of iron bridge over Catoctin Creek; aluminum tablet stamped "MARYLAND-272-ADJ"	272.190
Taylorstown, 2.6 miles northwest of, 50 feet east of road fork south, near short bend in road to north, 15 feet west of barn, on top of stone; chiseled square marked "479.6-U.S.B.M."	479.54
Lovettsville, in front face of post-office at G. F. Eamich's store, east side of door, between door and window; aluminum tablet stamped "MD-507-ADJ"	506.990

---

[a] One foot arbitrary adjustment was made between starting point and first bench mark of this line.

	Feet.
Lovettsville, 3.4 miles northwest of, 0.1 mile north of road fork, 150 feet north of second-class fork west, 1,000 feet east of house, 8 feet east of road by fence bars, in west side of large sandstone; aluminum tablet stamped "MD-471-ADJ"	470.829
Lovettsville, 7.1 miles northwest of, 0.4 mile west of sawmill, about 0.2 mile west of old house, at spring on left of road in front of house, 12 feet north of road between road and river, in top of large native rock; aluminum tablet stamped "ADJ 254"	253.601
Lovettsville, 8.7 miles northwest of; nail in north side at center of bridge over Shenandoah River at Harpers Ferry, marked "281"	281.39

POINT 1 MILE EAST OF HARPERS FERRY, SOUTH TO NEERSVILLE.

Neersville, 300 feet north of road forks, 0.2 mile north of former post-office, in northeast corner of schoolhouse; aluminum tablet stamped "615 ADJ".	614.682

SENECA QUADRANGLE.

EDWARDS FERRY, SOUTHEAST TO DRANESVILLE.

Mahala, 50 feet north of former post-office, north of pike, in big flat rock; tablet stamped "326"	326.031
Daysville, J. T. Palmer's house, in south wall of west chimney; tablet stamped "VA 314"	313.950

MOUNT VERNON QUADRANGLE.

DRANESVILLE, EAST TO GREAT FALLS.

Dranesville, 0.25 mile east of; opposite J. F. Duke's house, south of pike, 12 feet east of 30-inch oak tree at road forks, in 20 by 8 by 8 inch rock; tablet stamped "Va. 395"	394.937
Forestville, near southeast corner of east foundation of Oliver's store; tablet stamped "348 VA"	347.405

Pocahontas quadrangle.

TAZEWELL COUNTY.

The elevations in the following list are based on the height of permanent bench mark at Graham, established by precise leveling in 1909. The leveling was done by T. A. Green in 1909. Elevations in this quadrangle in West Virginia are not included in this bulletin.

DIVIDE AT HEAD OF ABBS VALLEY, SOUTHWEST TO SMITH STORE; THENCE NORTH TO STATE LINE (PART OF ADJUSTED CIRCUIT).

	Feet.
Smith store, 350 feet south of forks, 75 feet east of road, 200 feet west of Mrs. W. T. Harrison's barn, on west side of running stream, in sandstone; aluminum tablet stamped "2598 VA 1909"	2,597.895

STATE LINE, SOUTHEAST ALONG NORFOLK AND WESTERN RAILWAY, TO GRAHAM.

Virginia-West Virginia state line, railway crossing; top of rail	2,309.4
Flattop, 0.8 mile east of, on rock 40 feet east of milepost 370; chiseled square.	2,321.20
Falls Mills, in front of station; top of rail	2,330.1
Falls Mills, 1.5 miles east of, 500 feet west of milepost 368, north end of east abutment of railroad bridge 840; aluminum tablet stamped "2348"	2,347.640
Falls Mills, 2.8 miles east of, at old sawmill, 100 feet east of road crossing on north end of west abutment of iron railroad bridge 835; chiseled square.	2,370.10
Graham, in front of signal tower; top of rail	2,386.2

	Feet.
Graham, at northwest corner of station platform, on granite curbing; chiseled square	2,393.46
Graham, on west side of front entrance to Bank of Graham, third step above pavement; aluminum tablet stamped "2389"	2,389.450

STATE LINE, SOUTHWEST ALONG NORFOLK AND WESTERN RAILWAY, TO POCAHONTAS (MEAN OF TWO LINES).

Pocahontas, in front of station; top of rail	2,318.8
Pocahontas, on west side of front entrance to Bank of Pocahontas, in first step above pavement; aluminum tablet stamped "2320 VA 1909"	2,320.057

STATE LINE NEAR NEMOURS, W. VA., SOUTHWEST UP ABBS VALLEY TO POINT NEAR DIVIDE (PART OF ADJUSTED CIRCUIT).

Nemours, 1.1 miles southwest of, east of road, 20 feet west of gate, on limestone; chiseled square marked "U.S.B.M. 2334"	2,330.78
Nemours, 1.9 miles southwest of, west of road, at top of knoll, on limestone; chiseled square marked "U.S.B.M. 2395"	2,395.18
Nemours, 2.8 miles southwest of, at road forks, 300 feet east of large red barn, 30 feet north of gate east of road, in limestone; aluminum tablet stamped "2443 VA 1909"	2,443.501
Nemours, 4 miles southwest of, 300 feet south of Mr. Browning's house, west of road, at sharp bend, on limestone ledge; chiseled square marked "U.S.B.M. 2411"	2,411.52
Nemours, 4.9 miles southwest of, at junction with main road running east, 15 feet west of telephone pole at northeast corner of road junction, on limestone; chiseled square marked "U.S.B.M. 2441"	2,441.27
Nemours, 6.4 miles southwest of, south of road, on top of hill, north of fence, in sandstone bowlder; aluminum tablet stamped "2523 VA 1909"	2,522.908
Nemours, 7.5 miles southwest of, 0.3 mile southwest of J. G. Bailey's, north of road, on limestone outcrop; chiseled square marked "U.S.B.M. 2517"	2,516.72
Nemours, 8.3 miles southwest of, at junction with road running northwest, through gate, point on limestone, 5 feet north of W. A. Barrett's mail box, at southeast corner of road junction; mail box marked "U.S.B.M. 2529"	2,528.92

SMITH STORE, NORTH TO STATE LINE (PART OF ADJUSTED CIRCUIT).

Smith store, 1.5 miles northwest of, south of road, 50 feet west of sharp bend, on sandstone outcrop; chiseled square marked "U.S.B.M. 2601"	2,601.26

Middlesboro quadrangle.

LEE COUNTY.

The elevations in the following list were determined by a double line of primary leveling brought from a precise-level bench mark near Mascot, Tenn., to Cumberland Gap and thence by a single spur line to Wheeler. The leveling was done by F. L. Foust in 1903. Elevations in Kentucky and Tennessee are not included.

CUMBERLAND GAP, EAST ALONG LOUISVILLE AND NASHVILLE RAILROAD, TO WHEELER.

	Feet.
Cumberland Gap, at summit, on Kentucky-Tennessee-Virginia stone corner post; chisel point	1,648.47
Wheeler, 0.3 mile northeast of station, 75 feet south of switch stand, in southeast corner of large stone culvert; bronze tablet stamped "1256 LEXINGTON"	1,256.465

Abingdon quadrangle.

GRAYSON, RUSSELL, SMYTH, AND WASHINGTON COUNTIES.

The elevations in the following list were determined in 1908 and 1909 by J. B. Metcalfe, jr., by a single unchecked line from a point 0.3 mile northeast of Housley, Tenn., in Roan Mountain quadrangle to Damascus, Va. Other lines are closed circuits dependent on this line.

DAMASCUS, SOUTH ALONG LAUREL RAILWAY, TO LAUREL BLOOMERY; THENCE EAST ALONG HIGHWAYS TO LITTLE HORSE CREEK; THENCE NORTH TO POINT 3.1 MILES NORTHEAST OF KONNAROCK.

	Feet.
Little Horse Creek, 4.7 miles north of, near junction of Big Horse Creek and Mud Fork, near Bill Miller's house, 10 feet east of road, 20 feet northeast of forks, in ledge of rock; aluminum tablet stamped "2954"	2,953.662
Little Horse Creek, 8.5 miles north of, 8 feet east of road, 300 feet northwest of old house; cross on ledge of rock, marked "3984"	3,983.63
Little Horse Creek, 10.2 miles north of, about 0.25 mile from top of gap between Whitetop and Rogers mountains, 60 feet south of second-class road forks to southwest, 6 feet west of road; cross on ledge of rock, marked "4535"	4,534.20
Little Horse Creek, 10.2 miles north of, about 0.25 mile from top of gap between Whitetop and Rogers mountains, about 60 feet south of second-class road fork to southwest, about 7 feet west of road, in ledge of rock; aluminum tablet stamped "4535"	4,533.831
Konnarock, 6.8 miles northeast of, about halfway up mountain road, over gap between Whitetop and Rogers mountains, east of road; nail in root of chestnut tree, marked "4102"	4,101.23

DAMASCUS, NORTHWEST ALONG VIRGINIA-CAROLINA RAILWAY, TO ABINGDON.

	Feet.
Damascus, 2.4 miles northwest of, 20 feet west of railroad, 100 feet south of milepost A13, in ledge of limestone rock; aluminum tablet stamped "1834"	1,833.671
Baron station, about 0.5 mile southeast of, 8 feet north of railroad, 35 feet west of milepost A9, in limestone rock; aluminum tablet stamped "1763"	1,762.700
Watauga, 1 mile northwest of, 10 feet west of railroad, 260 feet north of bridge No. 3 over creek, in ledge of rock in cut; aluminum tablet stamped "1924"	1,923.707
Abingdon, south side of southeast corner of new building being put up by Mr. Sumner, about 3.5 feet from ground and 2 feet from east corner of same, facing on Main street, and 200 feet northeast of confederate monument, in brick wall; aluminum tablet stamped "2096"	2,095.386

ABINGDON, EAST ALONG NORFOLK AND WESTERN RAILWAY, TO MARION.

	Feet.
Abingdon, 3.8 miles east of, 10 feet north of railroad, 12 feet east of milepost "B-19 N-389," 50 feet east of cross roads, in rock; aluminum tablet stamped "2167"	2,166.715
Meadow View, 1,030 feet west of station, 12 feet north of railroad, on north end of culvert over small creek, in rock; aluminum tablet stamped "2110"	2,108.793
Emory, 2.2 miles east of, 20 feet south of railroad, southeast corner of stone culvert, 40 feet north of road, running parallel to railroad, 1,450 feet east of mile post "B-26 N-382," in top of rock; aluminum tablet stamped "2083"	2,082.674

	Feet.
Emory, 6.6 miles east of, 10 feet south of railroad, on southwest corner of culvert, 1,950 feet east of milepost "B-31 N-377," in rock; aluminum tablet stamped "2047"	2,046.533
Chilhowie, 0.8 mile east of, 6 feet south of railroad, on southwest abutment of railroad bridge over Middle Fork, Holston River, in top face of abutment; aluminum tablet stamped "1950"	1,949.456
Chilhowie, 2 miles east of, 10 feet east of bridge over Middle Fork, Holston River, on joint of south rail of railroad; marked "1964"	1,963.61
Chilhowie, 3.5 miles east of, 7 feet north of railroad, about 1 mile east of Sevenmile Ford, on northeast corner of abutment to trestle over Middle Fork, Holston River, also to arch over road, in top face of abutment; aluminum tablet stamped "2013"	2,012.162
Marion, 8 feet north of railroad, about 0.25 mile west of station, on top face of abutment to bridge over Middle Fork, Holston River; cross on top of rock, marked "2126.7"	2,126.04
Marion, on west side of station, 1 foot south of northwest corner and 4 feet from ground, in brick wall; aluminum tablet stamped "2145"	2,144.624

DAMASCUS, EAST ALONG VIRGINIA-CAROLINA RAILWAY, TO POINT 3.1 MILES NORTHEAST OF KONNAROCK.

Damascus, 0.2 mile west of station, south side of Main street, in east face of brick wall, 2.7 feet south of northeast corner of Bank of Damascus, 3.4 feet from ground; aluminum tablet stamped "1929"	1,928.344
Taylors Valley, 1,360 feet northwest of station, 7 feet east of railroad, in ledge of rock in cut; aluminum tablet stamped "2366"	2,365.210
Konnarock, 3,200 feet southwest of station, 10 feet north of railroad, in ledge of rock; aluminum tablet stamped "2896"	2,895.695
Konnarock, 3.1 miles northeast of, 12 feet north of road forks, on road to Chilhowie; nail in root of 4-foot red-oak tree, marked "3138.5"	3,137.87

POINT 3.1 MILES NORTHEAST OF KONNAROCK, NORTH ALONG HIGHWAYS, TO CHILHOWIE.

Konnarock, 3.7 miles northeast of, on road to Chilhowie, east side of road, south side of mountain; cross on ledge of rock, marked "3187.3"	3,186.61
Konnarock, 5 miles northeast of, on road to Chilhowie, on top of Skulls Gap, east side of road; nail in root of 2.5-foot white oak tree, marked "3659.8"	3,659.16
Konnarock, 7 miles north of, on north side of mountain, east side of road; nail in root of 1½-foot red-oak tree, marked "2975"	2,973.99
Konnarock, 9.4 miles north of, on road to Chilhowie, 35 feet east of road, 50 feet south of large spring with house over it, in limestone rock sticking out of bottom of hill; aluminum tablet stamped "2240"	2,239.212
Konnarock, 12.2 miles north of, on road to Chilhowie, 10 feet east of road, 250 feet south of large white house on east side of road and red barn on west side, in ledge of limestone rock; aluminum tablet stamped "2222"	2,220.999
Konnarock, 13.7 miles north of, on road to Chilhowie, 30 feet east of road forks, 2 feet above level of road; cross on ledge of rock, marked "2097.2"	2,096.60

MARION, NORTH ALONG HIGHWAYS, TO CHATHAM HILL; THENCE WEST TO HAYTER GAP; THENCE SOUTH TO ABINGDON.

Marion, 2.5 miles north of, on road to Chatham Hill, in forks of road to west, near Mr. Copenhaver's house; cross on ledge of rock, marked "2202"	2,201.43
Marion, 5.2 miles north of, on road to Chatham Hill, north side of mountain road, about 0.5 mile from bottom of same; cross on rock, marked "2433"	2,432.25
Marion, 6.2 miles north of, on road to Chatham Hill, east side of mountain road, just opposite old sawmill; cross on ledge of rock, marked "2834"	2,833.53

	Feet.
Marion, 7.8 miles north of, on road to Chatham Hill, 6 feet east of road, 300 feet north of where road crosses top of mountain, in ledge of rock; aluminum tablet stamped "3454"	3,453.478
Marion, 10.5 miles north of, on road to Chatham Hill, 3 feet west of road and 300 feet west of large barn; cross on ledge of rock, marked "2392.4"	2,391.78
Chatham Hill, 1 mile west of, 250 feet south of road forks, 60 feet west of White Oak Branch, 6 feet west of road, in ledge of limestone; aluminum tablet stamped "2050"	2,049.128
Chatham Hill, 2.7 miles west of, on road to Saltville, 6 feet west of road, 10 feet north of gate to field, at top of hill; cross on ledge of rock, marked "2330.4"	2,329.76
Chatham Hill, 6.9 miles west of, 220 feet west of road forks, also 200 feet west of where Cove Creek crosses road and about 100 feet southeast of Cove Creek schoolhouse, 6 feet north of road, 4 feet above level of road, in ledge of limestone; aluminum tablet stamped "1810"	1,808.841
Broad Ford, 1.2 miles west of, on road to Saltville, 6 feet north of road, 3 feet above level of road, in cut along North Fork Holston River, in slanting ledge of rock; aluminum tablet stamped "1758"	1,757.782
Saltville, 3.9 miles east of, on road to Saltville, 175 feet west of road forks, about 0.5 mile east of Southern Gypsum works, 3 feet east of road; cross on ledge of rock, marked "1741.6"	1,740.99
Saltville, 0.6 mile east of, 200 feet north of store at Cedar Branch, 8 feet north of road, on northwest abutment to bridge over North Fork Holston River, in top face; aluminum tablet stamped "1714"	1,713.111
Saltville, 2.3 miles west of, on road to Hayter Gap, 7 feet south of road forks and 45 feet northeast of house; cross on large rock, marked "1926"	1,925.34
Saltville, 5.1 miles west of, on road to Hayter Gap, 100 feet west of bridge over Tumbling Creek, in road forks north; cross on rock, marked "1765"	1,764.09
Saltville, 5.8 miles west of, on road to Hayter Gap, 30 feet north of road forks south; cross on sandstone, marked "1733"	1,732.54
Saltville, 5.8 miles west of, on road to Hayter Gap, 575 feet west of road forks south, about 0.8 mile southwest of Hazel Springs, 75 feet east of where creek crosses road, 6 feet north of road, in sandstone ledge; aluminum tablet stamped "1740"	1,739.913
Saltville, 9.3 miles east of, on road to Hayter Gap, 100 feet north of forks north where road goes over Hayter Gap, 16 feet west of road, in sandstone ledge; aluminum tablet stamped "1656"	1,655.950
Hayter Gap, 1 mile south of, on road to Abingdon, 10 feet northwest of road forks east, at east end of bridge over Wolf Creek, 150 feet northeast of junction of North Fork Holston River and Wolf Creek; cross on rock, marked "1532.4"	1,531.78
Hayter Gap, 1 mile south of, on road to Abingdon, 100 feet northeast of bridge over Wolf Creek, 75 feet northeast of road forks east, 10 feet east of road, in ledge of rock; aluminum tablet stamped "1536"	1,535.202
Hayter Gap, 4.7 miles south of, on road to Abingdon, 6 feet north of road forks south; cross on ledge of rock near house, marked "1498"	1,497.32
Hayter Gap, 6 miles south of, on road to Abingdon, 7 feet east of road, 50 feet south of store, on north bank of Tool Creek; cross on ledge of rock, marked "1500"	1,499.62
Hayter Gap, 6 miles south of, on road to Abingdon, 75 feet south of Baily's store on Tool Creek, 15 feet east of where road crosses Tool Creek, in ledge of rock; aluminum tablet stamped "1503"	1,502.043
Hayter Gap, 9.8 miles south of, 1 mile southwest of White's mill, on road to Abingdon, 20 feet northwest of second-class road west, 300 feet south of creek crossing, in ledge of rock; aluminum tablet stamped "2008"	2,007.636

HAYTER GAP, NORTHEAST ALONG HIGHWAYS, TO BELFAST MILLS (SPUR LINE).

	Feet.
Hayter Gap, 2.4 miles north of, on top of Clinch Mountain, in Hayter Gap, 10 feet west of road, in sandstone ledge; aluminum tablet stamped "3012".	3,010. 920
Hayter Gap, 4.6 miles north of, northeast of road forks east, 75 feet west of where Soop Creek crosses road, about 0.25 mile south of Rockdell; cross on rock, marked "2188.3"	2,187. 67
Hayter Gap, 6.1 miles north of, about 300 feet south of road forks west, leading to Elk Garden, 6 feet east of road, in limestone ledge; aluminum tablet stamped "2131"	2,130. 707
Old Rosedale, about 400 yards east of, 150 feet west of road forks north, leading to Honaker, 8 feet north of road, in limestone ledge; aluminum tablet stamped "2281"	2,280. 669
Rosedale, about 2.5 miles east of, 30 feet southwest of road forks north, south side of road; cross on rock, marked "2330.6"	2,330. 03
Rosedale, 2.8 miles east of, about 0.25 mile west of John Vessel's residence, 100 feet south of road forks, 10 feet east of road, in sandstone; aluminum tablet stamped "2314"	2,313. 810
Belfast Mills, 20 feet west of forks, 35 feet east of blacksmith shop; cross painted on rock, marked "2280"	2,279. 15
Belfast Mills, 1 mile east of, 75 feet south of road, 300 feet northeast of C. W. Grant's residence, 6 feet north of branch of Indian Creek, in limestone ledge; aluminum tablet stamped "2293"	2,292. 530

INDEX.

A. Page.
Abbyville 55
Aberdeen 22
Abingdon 65
Abingdon quadrangle 65–68
Accident 46
Accident quadrangle 46
Ajax 59
Alberton 26, 27
Alleghany 52
Allibone 23
Alpine 61
American Corners 18
Ammendale 30
Annapolis 28
Annapolis Junction 29, 31
Annapolis quadrangle 28
Appomattox quadrangle 60
Aqueduct Bridge 14
Arsenal grounds 14
Ashton 30
Avalon 29
Avondale 38

B.

Backbone 52
Bacons Castle 54
Bailey, C. B., work of 44
Bailey, G., work of 15, 21
Baldwin 51
Baldwin, D. H., work of 7
Baltimore 25
Baltimore quadrangle 24–25
Barclay 16
Barclay quadrangle 16–17
Barnesville 35
Baron 65
Bartholows 32
Bassett 48
Battery Park 54
Bayview 22, 25
Beatrice 56
Belair 23
Belair quadrangle 23
Belfast Mills 68
Beltsville 30
Benfield 28
Bentley 23
Benton Corners 16
Berlin 21
Berwyn 30
Betterton quadrangle 17
Bissell 41
Blacks 16

Page.
Blades 11
Bloomington 46
Blue Mountain 41
Bluestone Creek 55
Bolivar 36
Boones Mills 49
Bosley 25
Bowie 29
Boydton quadrangle 59–60
Bradenbaugh 23
Branchville 30
Brink 34
Broadcreek 11
Broad Ford 67
Brookland 13
Brookneal 90
Brookview 18
Brownsville 36
Bruceville 38
Bruen Mission Church 14
Brunswick 36
Buchanan 50, 61
Buckeystown 33
Buckley, G. S., work of 24
Bucktown 19
Buena Vista Spring 40
Buffalo Junction 55
Burketons 50
Burrsville 18
Burtonsville 30

C.

Callaghan 52
Calvert 22
Cambridge 17
Camden 25
Campbell 21
Campbell, N. A., work of 47
Capital Traction Building 14
Capitol 13
Catoctin 40
Catonsville 24
Cavetown 41
Cayots Corners 16
Cecilton quadrangle 16
Cedar Forest 57
Cedar Grove 34
Centerville 8, 17
Charlestown 22
Charlesville 32
Chatham Hill 67
Cherry Run 44
Chesapeake 22

Page.
Chesterton 17
Chesterton quadrangle 17
Chesterville 16
Cheswold 10
Chewsville 41
Chilhowie 66
Choate 8
Choptank quadrangle 17
Christie 60
Clarksburg 35
Clarks Ferry 56
Clarksville 30, 33, 48, 55, 59
Clarksville Junction 55
Clarksville quadrangle 48, 55–56
Clarkton 57
Clarysville 45
Clayton 9
Clifton Forge 51
Clifton Forge quadrangle 51
Clover 56, 57
Cloverdale 50
Clover quadrangle 56
Clunet, C. A., work of 15
Cluster Springs 60
Coates, W. G., work of 24
Cockeysville 25
Colburne 21
Coles Ferry 57
Columbia 30
Conaways 28
Concord 11, 18
Conowingo 22
Contee 30
Couches Bridge 8
Covington 51
Crabster 39
Crapo quadrangle 19
Crisfield 20
Crisfield quadrangle 20
Croaker Hill 52, 53
Crystal Hill 57
Cumberland 45
Cumberland Gap 64

D.

Dagsboro 11, 12
Daingerfield, J. S. B., work of 21
Damascus 31, 65, 66
Darlington 22
Darnestown 35
Dawsonville 35
Day 31
Daysville 63
Deal Island quadrangle 20
Deemer, R. S., work of 52
Deerfield 40
Deer Park 46, 59
Deerwood Fork 59
Delaware 7–13
Denbigh 53
Denniston 60
Denton 18
Denton quadrangle 18
Detour 38, 39
Dillon 61
District of Columbia 13–15

Page.
Dorsey 29
Dorseys Run 27
Doubs 33
Douglas, E. M., work of 7
Dover 10
Dover quadrangle 9–10, 16–17
Downs Chapel 9
Dranesville 63
Drum Point quadrangle 19
Duncans Lane Bridge 25

E.

Eagle Point 60
Eagle Rock 51
Earleville 16
Easby Point 15
East Allegheny 52
Easton 17
Eckington 13
Eden 20
Edesville 17
Edgemont 41
Edwards Ferry 35
Elba 58
Elioak 30
Elk Ridge 29
Elkton 22
Elkton quadrangle 22
Ellendale 10
Ellendale quadrangle 10
Ellerton 42
Ellicott City 26
Ellicott City quadrangle 26–27
Elvaton 28
Emmitsburg 40
Emmitsburg quadrangle 39–40
Emory 65, 66

F.

Fairland 30
Fairlee 17
Fairview 22
Faith Chapel 14
Falls Mills 63
Farmer, R. A., work of 31, 62
Farmers 58
Federal Hill 23
Federalsburg 18
Ferrum 49
Fincastle 62
Fincastle quadrangle 50–51, 62
Flattop 63
Flintstone 44
Flintstone quadrangle 44–45
Florence 31
Floyd 45
Forestville 63
Foust, F. L., work 64
Fowblesburg 27
Fowling Creek 18
Frankford 12
Frankford quadrangle 12
Franklin City 20, 52
Frederick 32, 33
Frederick Junction 32, 33
Fredericktown 16
Friendsville 46

Page.
Frostburg 45
Frostburg quadrangle 45
Funkstown 42

G.

Gaither 27
Gaithersburg 34
Gala 51
Galt 39
Gamber 26
Gannett, S. S., work of 7
Gapland 36
Garrett Park 34
Gay street 25
Germantown 34, 35
Georgetown 11, 12
Georgetown quadrangle 11–12
Gilman, H. M., jr., work of 9
Gilmore Mills 61
Glade Hill 59
Glasgow 8
Glenburnie 28
Glen Wilton 51
Gloucester 53
Gloucester Point 53
Golden Hill 19
Goldsboro 16
Goldsborough, C., work of 9, 15
Gorman 46
Gorsuch 27
Goshen 34
Graceham 39
Grafton 54
Graham 63, 64
Granogue 8
Grantsville 45
Grantsville quadrangle 45
Grays 26
Great Falls 34
Green, B. J., work of 15
Green, T. A., work of 31, 52, 61, 63
Green Hill 57
Green Ridge 44
Greenwood 10
Griffin 18
Grimes 37, 43
Grit 58
Grove 53
Guilford quadrangle 52
Gum Swamp 19

H.

Haden 51
Hagerstown 41, 42, 43
Hagerstown quadrangle 41–43
Halbert, E. O., work of 55
Halethorpe 29
Halfway 43
Halsteads Point 53
Hampstead 27
Hampton 55
Hampton quadrangle 54–55
Hancock 44
Hancock quadrangle 44
Hanesville 17
Hanover 29
Harpers Ferry 35, 37

Page.
Harrington 10
Harrington quadrangle 10, 18
Harris, J. M 35, 38
Hartley 9
Harwood 29
Havre de Grace 23
Havre de Grace quadrangle 22–23
Hayter Gap 67–68
Hazels Corners 9
Henry 48
Henrytown 27
Herring Run 25
Heurich brewery 15
Highfield 40
Highgate 54
High Point 23
Hillsboro 18
Hobbs 18
Hockessin 8
Hodges, J. W., work of 8, 15, 16, 21, 24, 52
Hollingsworth 16
Hollins 50
Hollofield 26
Hoods Mills 32
Horton, A. H., work of 55
Houston 60
Hoyes 46
Hurlock quadrangle 18
Hurt 58
Hutchins, R., work of 15, 24, 31
Hyattstown 32

I.

Ijamsville 33
Ijamsville quadrangle 32–33
Ilchester 26
Indianrock 61
Ingleside 16
Iron Gate 51
Island Creek 59
Isle of Wight quadrangle 54

J.

Jamestown 54
Jamestown quadrangle 54
Jefferson 36
Jerrys Run 52
Jessup 31
Jones 28

K.

Kearney 46
Keedysville 37
Kendall Green Baptist Church 14
Kensington 34
Keyser 45
Kings Corners 54
Kingsdale 39
Klej Grange 20
Knowles 12
Knowles Crossroads 11
Konnarock 65, 66

L.

Lacks Ferry 56
Ladiesburg 38
Lake Royer 41

Page.
Lakesville 19
Langdon 13
Lansdowne 25, 29
Lauraville 24
Laurel 11, 29, 30
Laurel quadrangle 29–31
Layhill 34
Laytonsville 34
Lee Hall 53
Le Gore 39
Lennig 57
Leonard, T. D., work of 9, 15
Leslie 22
Leslie quadrangle 49, 59
Level Run 57
Lewisburg quadrangle 51
Lewistown 40
Libbey, R. L., work of 47, 55, 61
Libertytown 31, 32
Lick Run 51
Linchester 18
Linkwood 18
Linwood 38
Lisbon 31
Lithia 50
Little Bethel Church 54
Little Horse Creek 65
Little Orleans 44
Locust Grove 16
Longridge 20
Longwood 61
Longwoods 17
Lovettsville 62, 63
Lowes 12
Lowmour 51
Loys 39
Lynchburg quadrangle 57–58

M.

McAleer 39
McDonough 8
McGinnes 16
McKeever Ferry 57
Macton 23
Mahala 63
Mallow 51
Manchester 27
Mardela Springs 19
Marion 20, 66, 67
Marriottsville 27
Marshall, R. B., work of 7
Martinsburg quadrangle 37
Martinsville 48
Martinsville quadrangle 48
Marydel 16
Maryland 15–47
    aid of 7
Massey 16, 52
Mayo 60
Meadow View 65
Medford 38
Menla 58
Middleburg 38
Middlepoint 42
Middlesboro quadrangle 64
Middletown 9, 36
Middletown quadrangle 35–37, 62–63

Page.
Millington 16
Millsboro 11, 12
Milton 17
Mission 12
Mistletoe Springs 30
Mondel 37
Moneta quadrangle 58–59
Monkton 24
Monrovia 33
Montevideo 31
Moores Place 54
Moss Run 52
Motley 58
Motters 40
Mountain Lake 46
Mount Airy 32
Mount Airy quadrangle 31–32
Mount Carmel 24
Mount Pleasant 9, 32
Mount Royal 25
Mount Savage 45
Mount Tabor 37
Mount Vernon quadrangle 63
Mount Washington 25
Mount Winans 25
M Street Bridge 14
Muirkirk 30
Murat 61, 62
Myersville 37, 42

N.

Nace 50
Nanticoke quadrangle 19
Nathalie 57
Nathalie quadrangle 56–57
National Museum 14
Natural Bridge 61
Natural Bridge special quadrangle 50, 61–62
Navy-Yard 13, 14
Navy-Yard Bridge 14
Neathery 57
Neersville 63
Nelson 55
Nemours 64
Newark 8, 21
Newcastle 8
New Germany 45
New London 33
New Midway 39
Newport News 55
Newton 18
New Windsor 38
Noland 57
Norbeck 34
North Junction 41
Novelty 59

O.

Oakdale 62
Oak Grove 11, 19
Oakland 46
Oakland quadrangle 46–47
Oakley 10
Oakton 46
Oaktree 53
Odenton 28
Odessa 9

Page.
Oella.......... 26
Old Rosedale.......... 68
Oldtown.......... 45
Olney.......... 34
Orange Grove.......... 29
Ordinary.......... 53
Owens.......... 10
Oxford quadrangle.......... 17

P.

Palmer, W. C., work of.......... 15, 24
Park.......... 45
Parkton quadrangle.......... 23-24
Parkville.......... 24
Parsonsburg.......... 21
Pawpaw quadrangle.......... 44
Penhook.......... 59
Pen Mar.......... 41
Pepper.......... 11, 12
Perth.......... 60
Peters Corners.......... 17
Petersville.......... 36
Pettibone, O. L., work of.......... 9, 15, 21
Piedmont quadrangle.......... 46
Pig River.......... 58
Pikesville.......... 24
Piney Creek.......... 39
Piney Grove.......... 45
Pittsville.......... 58
Pittsville quadrangle.......... 21
Pocahontas.......... 64
Pocahontas quadrangle.......... 63-64
Pocomoke City.......... 20
Poolesville.......... 35
Port Deposit.......... 22
Porter Bridge.......... 22
Potomac.......... 34
Potomac avenue.......... 41
Pratt.......... 44
Princess Anne.......... 20
Princess Anne quadrangle.......... 20
Principio.......... 22, 23
Principio Furnace.......... 23
Pumphrey.......... 28
Pylesville.......... 23

Q.

Quantico.......... 20

R.

Randolph.......... 56
Rapps Mill.......... 61, 62
Redhouse.......... 46
Red Lion.......... 8
Redwood.......... 59
Reels Mill.......... 33
Reisterstown.......... 26
Relay.......... 28, 29
Relay quadrangle.......... 28-29
Reliance.......... 19
Rhodesdale.......... 18
Ridgely.......... 18
Ridgeville.......... 31
Ridgeway.......... 48
Rising Sun.......... 22
Roanoke.......... 49, 50
Roanoke quadrangle.......... 49-50

Page.
Robbins.......... 10
Roberts.......... 16
Rockdale.......... 27
Rockville.......... 34
Rockville quadrangle.......... 33-34
Rocky Mount.......... 49, 59
Rocky Mount quadrangle.......... 48-49
Rocky Point.......... 61
Rocky Ridge.......... 39
Rohersville.......... 36
Rosedale.......... 25, 68
Ross.......... 10

S.

Sabillasville.......... 40
St. Denis.......... 29
St. Georges.......... 8
St. James.......... 43
St. Michaels quadrangle.......... 17
St. Paul's A. M. E. Church.......... 14
Salisbury.......... 20, 50
Salisbury quadrangle.......... 20
Saltpetre Cave.......... 50
Saltville.......... 67
Sandy Hook.......... 35
Sandy Level.......... 59
Sandy Spring.......... 33
Sang Run.......... 46
Sassafras.......... 16, 53
Saunders Siding.......... 49
Savage.......... 30
Scotland.......... 54
Scottsburg.......... 61
Seaford.......... 10, 11
Seaford quadrangle.......... 10-11, 19
Security.......... 41
Selbyville.......... 13
Selbyville quadrangle.......... 13
Semper, C. H., work of.......... 9, 16, 38, 47
Seneca quadrangle.......... 34-35, 63
Septa.......... 54
Seventh street power house.......... 14
Severn.......... 28
Shane.......... 23
Sharpsburg.......... 37
Sharrets.......... 39
Shawan.......... 25
Shepherdstown.......... 37
Sherwood.......... 24
Shockeys.......... 41
Signpine.......... 53
Sixmile House.......... 44
Smith, C. M., work of.......... 21, 44
Smithfield.......... 54
Smithsburg.......... 41, 42
Smithsonian Institution.......... 14
Smithville.......... 19
Smoketown.......... 42
Snow Hill.......... 21
Snow Hill quadrangle.......... 20-21, 52
Soudan.......... 48
South Boston.......... 60
South Clarksville.......... 55, 56
Sparks.......... 23
Spencerville.......... 30
Spielman.......... 43
Spring Mills.......... 38

Page.
Springwood 50,62
Stanton 8
Starkey 49
Starkley Corner 17
Stillpond 17
Stockley 11
Stotts 13
Strayhorn's mills 22
Sudlersville 16
Summit Bridge 9
Sunnyside 30
Sutton, Frank, work of 7
Sycamore 58
Sykesville 26

T.

Takoma Park 13
Taneytown 39
Taneytown quadrangle 38–39
Tanyard 18
Taylor 23
Taylorstown 62
Taylors Valley 66
Taylorsville 31
Thayerville 46,47
Thunder Gush Stream 8
Thurmont 39–40
Timonium 25
Toano quadrangle 52
Tolchester quadrangle 17
Toshes 58
Town Creek 48
Townsend 9
Towson 24
Trappe 17
Trinidad 13
Troutville 50
Trump 23
Tufts, W. O., work of 31
Tuscarora 35
Twilley 21

U.

Union Bridge 38
Union dam 26
Union Hall 59
Union Mills 39
Unionville 31
Unity 33
Urbana 32

V.

Vale Summit 45
Vienna 19
Vineyard 29
Virgilina quadrangle 60–61
Virginia 47–68
    aid of 7

W.

Page.
Wagners Crossroads 42
Waldesboro 49
Wakefield 38
Walkersville 32
Washington Gas Co. office 15
Washington Grove 34
Washington Monument 13,14,15
Watauga 65
Waterbury 28
Waterloo 29
Watersville 32
Watkins 56
West Baltimore 25
West Beaver 42
Westchester quadrangle 7–8
West End 53
West Friendship 26
Westminster 27,38
Westminster quadrangle 27
Westover 20
Weverton 35,36
Wheaton 34
Wheeler 64
Whiteburg 20
Whitehall 24
Whitehall crossroads 9
Whitehaven 19
Whiteleysburg 18
Whitemarsh 53
Williamsburg 53
Williamsburg quadrangle 53
Williamsport 43
Williamsport quadrangle 43
Williston 18
Wilmington 8
Wilmington quadrangle 7,8–9
Wilson, H. M., work of 7
Winans 28
Wingate 19
Winstead, W. R., work of 35,62
Winthrop Heights 13
Wirtz 49
Wolfsville 42
Wolftrap 60,61
Wood, H., work of 8,21,44
Woodbine 31,32
Woodenburg 27
Woodsboro 39
Woodside 10
Woodstock 26,27
Wright 49
Wye Mills 17
Wyoming 10

Y.

Yorktown 53,54
Yorktown quadrangle 53–54

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETIN 437

RESULTS OF SPIRIT LEVELING
IN
MAINE, NEW HAMPSHIRE, AND VERMONT
1896 TO 1909, INCLUSIVE

R. B. MARSHALL, CHIEF GEOGRAPHER

**WORK DONE IN COOPERATION WITH THE STATE OF MAINE
DURING 1899 TO 1909, INCLUSIVE**

WASHINGTON
GOVERNMENT PRINTING OFFICE
1910

CONTENTS.

Page.

Introduction 5

  Scope of the work 5

  Personnel 5

  Classification 6

  Bench marks 6

Maine 7

  Precise leveling 7

    Bath, Freeport, Gray, Kezar Falls, Portland, and Sebago quadrangles (Cumberland and Oxford counties) 7

  Primary leveling 9

    Anson, Augusta, Bingham, Brassua Lake, Moosehead Lake, Norridgewock, Skowhegan, The Forks, Vassalboro, and Waterville quadrangles (Kennebec, Somerset, and Piscataquis counties) 9

    Buckfield, Lewiston, Livermore, Norway, and Poland quadrangles (Androscoggin, Cumberland, Franklin, Kennebec, Oxford, and Sagadahoc counties) 13

    Bethel, Fryeburg, Kezar Falls, and Rumford quadrangles (Cumberland, Oxford, and York counties) 16

    Belfast, Castine, and Rockland quadrangles (Knox and Waldo counties) 18

    Bangor, Bluehill, Bucksport, Ellsworth, Mount Desert, Orland, and Orono quadrangles (Hancock, Penobscot, and Waldo counties) 19

    Lincoln, Mattawamkeag, Millinocket, Passadumkeag, and Winn quadrangles (Penobscot County) 23

    Cherryfield quadrangle (Washington County) 25

    Cutler and Eastport quadrangles (Washington County) 26

    Augusta, Bath, Bethel, Buckfield, Dixfield, Freeport, Gardiner, Lewiston, Livermore, and Rumford quadrangles (Androscoggin, Cumberland, Franklin, Kennebec, Oxford, and Sagadahoc counties) 27

    Several unnamed quadrangles (Penobscot, Piscataquis, and Somerset counties) 30

New Hampshire 34

  Precise leveling 34

    Benton, Campton, Ossipee, Rumney, Silver Lake, Squam Lake, Winnepesaukee, and Woodsville quadrangles (Belknap, Carroll, and Grafton counties) 34

  Primary leveling 36

    Boscawen, Squam Lake, and Winnepesaukee quadrangles (Belknap, Carroll, and Grafton counties) 36

    Claremont, Concord, Dover, Hanover, Haverhill, Manchester, Mascony Lake, Milford, Mount Kearsarge, Nottingham, Peterboro, Sunapee, Suncook, and York quadrangles (Cheshire, Grafton, Hillsboro, Merrimac, Rockingham, and Sullivan counties) 38

    Whitefield quadrangle (Coos and Grafton counties) 44

    Gorham and Milan quadrangles (Coos County) 45

Page.
Vermont 46
  Precise leveling 46
    Hanover, Thetford, and Woodsville quadrangles (Orange and Windsor counties) 46
  Primary leveling 47
    Claremont and Hanover quadrangles (Windsor County) 47
    Whitefield quadrangle (Essex County) 49
    Burlington, Brandon, Camels Hump, Middlebury, Milton, Potato Hill, and Ticonderoga quadrangles (Addison, Crittenden, and Rutland counties) 49
    Bennington quadrangle (Bennington County) 52
Index 55

RESULTS OF SPIRIT LEVELING IN MAINE, NEW HAMPSHIRE, AND VERMONT, 1896 TO 1909, INCLUSIVE.

R. B. Marshall, *Chief Geographer*.

INTRODUCTION.

Scope of the work.—The results herein given are based on a common mean sea-level datum. The main control is the adjustment made in 1903 by the Coast and Geodetic Survey of a great net of precise levels which combines work of various organizations and covers the eastern half of the United States. The precise-level lines which lie wholly or partly in these States are (1) from Portland northeast along the Maine Central Railroad to Brunswick, Me.; (2) from Portland along the Maine Central Railroad to Cornish, thence west along highways to the New Hampshire-Maine state line, thence westward via Lake Winnepesaukee across New Hampshire to South Newbury, Vt., thence down the Connecticut River Valley to White River Junction, Vt., where a check was obtained on a bench mark established by primary leveling extended from a tidal bench mark near Portsmouth, N. H.

All results of spirit leveling in these States previously published by the United States Geological Survey and all later work are included in this report, readjusted and rearranged by quadrangles. Descriptions and elevations of bench marks are given for 15 out of 16 counties in Maine, for 9 out of 10 counties in New Hampshire, and for 7 out of 14 counties in Vermont.

The results of leveling by the water resources branch in Maine and New Hampshire are also included.

Personnel.—The field work during 1898 to 1906, inclusive, was done under the direction of H. M. Wilson, geographer, and that during 1907 to 1909, inclusive, was done under Frank Sutton, geographer. The work since January, 1908, was done under the general direction of R. B. Marshall, chief geographer. Credit is given in the heading of each list to the different levelmen.

The leveling in Maine was done in cooperation with the State during the years 1899 to 1909, inclusive. The leveling in New Hampshire and Vermont was not done in cooperation with the States.

The office work of computation and compilation of results was done by D. H. Baldwin, topographer, under the immediate supervision of S. S. Gannett, geographer, and since 1907 under the general direction of E. M. Douglas, geographer.

Classification.—The lists are separated into two classes, precise and primary, distinguishing the degree of refinement in the method of leveling employed; and each list is subdivided so that the results for each quadrangle are combined. The elevations under precise leveling were determined by lines run in both forward and backward directions, a high-grade level and rated rods being used and special precautions being taken in observation and reduction to correct error and make the results continuously good; elevations under primary leveling were determined mostly by single lines run with the Y level, precautions being taken against only the principal sources of error, and depending upon the closure of circuits for a check. The allowable limit of error observed on the precise lines is represented in feet by the formula $0.017\sqrt{D}$, in which D is the distance between bench marks in miles. The limit in feet on primary work is $0.05\sqrt{D}$, in which D is the length of circuit in miles.

Bench marks.—The bench marks, the locations of which are given in the following lists, are of three general forms: First, a circular bronze or aluminum tablet 3½ inches in diameter and one-fourth inch thick, appropriately lettered, having a 3-inch stem cemented in a drill hole, generally in the vertical wall of a public building, a bridge abutment, or other substantial masonry structure. The second form, employed where masonry or rock is not accessible, consists of a hollow wrought-iron post 3½ inches in outer diameter and 4 feet in length, split at the bottom and expanded to 10 inches at base, so as to prevent both the easy subsidence of the post and the malicious pulling of it out of the ground. These posts are generally sunk 3 feet in the ground; the iron is heavily coated with asphalt, and over the top of the post is riveted a bronze tablet similar to that described above. The third form consists of a copper bolt 1 inch in diameter and 4 inches long, which is split at one end and expanded in a drill hole in masonry by driving on a brass wedge. But few bench marks of the third class have been used in these States, and their use has now been discontinued.

The numbers stamped on the bench marks represent the elevations to the nearest foot above mean sea level, as determined by unadjusted levels in the field. The notes have since been subjected to changes resulting from the adjustments necessary to close circuits and to reduce to mean sea level through connection with or readjustment of the precise-level net of the United States. Some of the elevations as finally accepted and printed herein therefore differ from those submitted as bench-mark numbers by 1 or 2 feet. This method of numbering bench marks, rather than any attempt at serial numbering, has been adopted where many levelmen are working in a given area at the same time as less liable to lead to confusion in identification of bench marks and because such bench-mark number also affords an approximate statement of the elevation. It is assumed that engineers and others finding these bench marks so stamped in the field will communicate with the Director of the United States Geological Survey in order to obtain the accepted elevation to hundredths or thousandths of a foot. Bench marks established under cooperation are stamped with the state name.

For a complete list of standard bench marks in any quadrangle refer to both precise and primary lists. Descriptions of bench marks in adjoining States, but within the border quadrangles herein listed, are not given in this bulletin.

Any person finding bench marks in the following lists mutilated or destroyed will confer a favor by notifying the Director, United States Geological Survey, Washington, D. C.

MAINE.

PRECISE LEVELING.

Bath, Freeport, Gray, Kezar Falls, Portland, and Sebago quadrangles.

CUMBERLAND AND OXFORD COUNTIES.

The elevations in the following list are the result of two lines of precise levels run in 1906: One line from Portland, northeast along the Maine Central Railroad, to Brunswick (where it joins the double-rodded primary line of the water-resources branch from Augusta), and thence up the Androscoggin River; the other line from Portland, northwest along the Maine Central Railroad, to Cornish, and thence west along highways through the southern part of Kezar Falls quadrangle to the New Hamsphire state line. Both lines are based on a bench mark established by the United States Engineer Corps in 1901 from previous ones set by the Coast and Geodetic Survey, now destroyed, the heights of which were determined from tidal records made in 1852–53 and in 1864–1866. The bench mark is the bottom of a ½-inch drill hole one-eighth inch deep on upper surface of water table between columns at right of the Commercial street entrance to the custom-house building. Its elevation is 14.069 feet above mean sea level and the mean range of tide at Portland as corrected in 1896 is 8.824 feet. The methods, instrument, and limit of error were practically those now used by the Coast and Geodetic Survey, except that the rods were 3.5 yards long, graduated to yards and hundredths with incased thermometers.

The lines are leveled independently in both forward and backward directions, broken by temporary bench marks into sections 0.5 mile to 1.25 miles long. On all sections upon which the backward and forward measures differed in feet more than 0.017 times the square root of the distance between bench marks in miles, the line was rerun until a pair in opposite directions came within limits. All corrections necessary to obtain accurate results were made.

The leveling was done by N. A. Campbell, chief of the party.

PORTLAND QUADRANGLE.

PORTLAND, NORTHEAST ALONG MAINE CENTRAL RAILROAD, TO CUMBERLAND JUNCTION.

	Feet.
Portland, on step at right side of main entrance to city hall; bronze tablet stamped "67"	66.582
Portland, on upper surface of water table between columns at right of Commercial street entrance to custom-house, bottom of ½-inch drill hole one-eighth inch deep (above low water, 18.481)	14.069
Portland, 0.9 mile south of custom-house, on foundation of highway bridge over railroad, east side of track; chiseled square	12.210
Portland, right side of main entrance to Union Station; aluminum tablet stamped "26"	26.070
Woodfords, in front of station; top of rail	65.7
Deering Junction, in front of station; top of rail	103.8
Deering Junction, 0.2 mile northeast of, southeast side of track, 225 feet northeast of highway, in west side of granite ledge; aluminum tablet stamped "110"	109.530
Deering Junction, 2.9 miles northeast of, railroad bridge over Presumpscot River, northwest side of track, on top of northeast abutment; aluminum tablet stamped "48"	47.694

PORTLAND, ALONG MAINE CENTRAL RAILROAD, TO NEWHALL.

Portland, on right side of main entrance to Union Station (porte-cochère), in curb; aluminum tablet stamped "26"	26.070
Cumberland Mills, 0.2 mile northwest of, south side of track, west abutment of railroad bridge, in retaining wall; aluminum tablet stamped "65" (error in stamping)	68.599
South Windham, 110 feet east of first road east of station parallel with railroad, south of T road, 3 feet higher than road, in rock ledge; aluminum tablet stamped "154"	153.906
Newhall, in front of station; top of rail	168.092

GRAY QUADRANGLE.

AT CUMBERLAND JUNCTION.

Cumberland Junction, 250 feet south of station, southeast side of track, top of culvert; aluminum tablet stamped "58"	57.984
Cumberland Junction, in front of station; top of rail	59.0

FREEPORT QUADRANGLE.

CUMBERLAND JUNCTION, NORTHEAST ALONG MAINE CENTRAL RAILROAD, TO BRUNSWICK.

Cumberland Junction, 3.6 miles northeast of, bridge over Royal River, northwest side of track, on top of south abutment; aluminum tablet stamped "92"	91.794
Yarmouth Junction, in front of station; top of rail	89.8
Yarmouth, 1.7 miles northeast of, 364 feet southwest of overhead highway bridge, southeast side of track, on ledge; chiseled square	73.212

	Feet.
Yarmouth Junction, 4 miles northeast of, southwest end of southeast abutment of overhead highway bridge; aluminum tablet stamped "90"	89.950
Freeport, in front of station; top of rail	129.6
Freeport, 0.2 mile northeast of, northwest side of track just south of highway, in rock ledge; aluminum tablet stamped "133"	132.504
Freeport, 4.1 miles northeast of, southeast side of track, in rock ledge; aluminum tablet stamped "136"	135.529

BATH QUADRANGLE.

AT BRUNSWICK.

Brunswick, west side of Union Station, about 16 feet from southwest corner of grating over basement windows, in curb 6 inches from wall; aluminum tablet stamped "67"	66.519
Brunswick, left of main entrance to city hall, in wall; aluminum tablet stamped "70"	69.589
Brunswick, south side of Union Station, in doorstep leading to basement; bronze tablet stamped "67"	67.094

SEBAGO QUADRANGLE.

SEBAGO, ALONG MAINE CENTRAL RAILROAD, TO POINT 2.1 MILES NORTHWEST OF MATTOCKS.

Sebago, in front of station; top of rail	275.453
Sebago Lake, 0.3 mile northwest of, right side of track, in rock ledge; aluminum tablet stamped "287"	287.555
Richville, in front of station; top of rail	313.740
Richville, 0.6 mile northwest of, right side of track, in rock; aluminum tablet stamped "293"	293.283
Steep Falls, in front of station; top of rail	303.432
Steep Falls, 0.2 mile northwest of, right side of track, in rock; aluminum tablet	300.370
Mattocks, in front of station; top of rail	283.331
Mattocks, 2.1 miles northwest of, right side of track, in rock; aluminum tablet stamped "320"	320.050

KEZAR FALLS QUADRANGLE.

CORNISH, WEST ALONG HIGHWAYS TO 1.2 MILES WEST OF PORTER.

Cornish, at forks of Maine and Cumberland streets, on right side going east, in side yard of dwelling, in rock; aluminum tablet stamped "347"	346.943
Kezar Falls, northeast of bridge, in Hollem's lot, 60 feet from road, 12 feet east of west fence, in rock; aluminum tablet stamped "381"	381.345
Porter, 1.2 miles west of, north side of road, in rock; aluminum tablet stamped "399"	398.873

PRIMARY LEVELING.

Anson, Augusta, Bingham, Brassua Lake, Moosehead Lake, Norridgewock, Skowhegan, The Forks, Vassalboro, and Waterville quadrangles.

KENNEBEC, SOMERSET, AND PISCATAQUIS COUNTIES.

The elevations in the following list are based on tidal records of the Coast and Geodetic Survey at Portland. The work was previously based on Augusta datum from tidal records of the Coast and Geodetic Survey at Hallowell; but the results of a double-rodded line run in 1905 by the water-resources branch of the United States Geological Survey from Augusta to Brunswick, checking upon the Coast and Geodetic Survey gage bench marks at Abagadassett Point and Pleasant Point with a connection also at Moosehead from Penobscot River levels, showed considerable error. A line of precise levels was therefore run from Portland (where a more reliable sea-level value could be obtained) to Brunswick, from which was derived a correction of 2.651 feet to be added to the original unpublished values of the water-resources branch and 2.593 to be added to the original unpublished elevations of the bench marks on Augusta datum from Augusta to Moosehead. The closures upon Coast and Geodetic Survey gage bench marks by the water-resources branch line corrected to Portland datum are as follows: At Point Pleasant, +1.11 feet; at Abagadassett Point, +0.41 feet; at Hallowell bench mark 2, +2.651 feet; at Augusta, +4.608 feet.

A small discrepancy with levels brought by the topographic branch from Bangor up the Penobscot River, in 1904, to Norcross and thence by wye and water levels in the four succeeding years by the water-resources branch to Moosehead, has been adjusted into leveling of the water-resources branch.

The leveling was done in 1903 and 1904 by F. J. McMaugh.

AUGUSTA QUADRANGLE.

HALLOWELL, NORTH ALONG MAINE CENTRAL RAILROAD, TO AUGUSTA.

	Feet.
Hallowell, on south face of stone snubbing post of Granite Company's wharf; horizontal chisel mark[a] (Coast and Geodetic Survey bench mark No. 1)	13.804
Hallowell, Water street (southeast) corner of cotton mill; horizontal chisel mark (Coast and Geodetic Survey bench mark No. 2; discarded elevation by Coast and Geodetic Survey equals 24.44 feet above mean water level)	27.091
Augusta, at northwest corner of west wing of state house; aluminum tablet stamped (reestablished in 1909 by the water-resources branch)	152.950
Augusta, in the upper and outer stone on top of the small ornamental tower, on the southwest corner of river wall around the arsenal; drilled hole[b]	21.168

VASSALBORO QUADRANGLE.

AUGUSTA, NORTH ALONG MAINE CENTRAL RAILROAD, TO VASSALBORO.

Augusta, 4 miles northeast of, 865 feet north of milestone "66 and 185," in south granite abutment of railroad culvert; aluminum tablet stamped "34 AUGUSTA"	37.046
Vassalboro, 4.5 miles south of, at sawmill, on top of stone culvert; chisel mark	51.53

---

[a] This bench mark is assumed to have settled 0.344 foot, as found by checked connection with bench mark No. 2. Discarded elevation by Coast and Geodetic Survey equals 11.50 above mean water level.

[b] Elevation by the water-resources branch, United States Geological Survey, exact point of Coast and Geodetic Survey bench mark impossible to determine; discarded elevation by Coast and Geodetic Survey equals 16.56 above mean water.

	Feet.
Vassalboro, stone culvert near milestone "73 and 183," Portland and Vanceboro, in southeast corner; aluminum tablet stamped "39 AUGUSTA"	42.027
Vassalboro, in front of station; top of rail	57.4

WATERVILLE QUADRANGLE.

VASSALBORO, NORTH ALONG MAINE CENTRAL RAILROAD, TO GOODWILL.

Winslow, 0.5 mile south of, 5.5 miles north of Vassalboro, in east abutment of new bridge over Kennebec River; aluminum tablet stamped "53 AUGUSTA"	55.584
Winslow, in front of station; top of rail	54.8
Waterville, west side of canal, on grounds of Hollingsworth & Whitney, in stone wall; brass cap	78.157
Waterville, east bank of river, 30 feet south of dam, 140 feet north of railroad bridge, in ledge marked "Top of flash boards;" copper bolt	52.16
Shawmut, in west wall of engine house of the Lawrence Newhall plant; aluminum tablet stamped "113 AUGUSTA"	115.226
Shawmut, in front of station; top rail	126.0
Goodwill farm, in front of station; top of rail	119.6
Hinckley, in front of station; top of rail	132.6
Goodwill, 1.8 miles north of, in milestone "7 miles to Skowhegan, 95 miles to Portland;" aluminum tablet stamped "126 AUGUSTA"	128.580

SKOWHEGAN QUADRANGLE.

AT SKOWHEGAN.

Skowhegan, in front of station; top of rail	172.8
Skowhegan, in corner of high school building, on island; aluminum tablet stamped "172 AUGUSTA." (Reported as having the end defaced)	174.484
Skowhegan, 0.3 mile south of station, on coping stone at west end of south abutment of railroad bridge; aluminum tablet stamped "176 AUGUSTA"	178.897

NORRIDGEWOCK QUADRANGLE.

SKOWHEGAN, SOUTHWEST ALONG SKOWHEGAN AND NORRIDGEWOCK ELECTRIC RAILROAD, TO NORRIDGEWOCK.

Norridgewock, in northeast corner of hotel; aluminum tablet stamped "199 AUGUSTA"	201.854
Norridgewock, in front of station; top of rail	202.3

ANSON QUADRANGLE.

NORRIDGEWOCK, NORTH ALONG SOMERSET RAILWAY, TO ANSON.

Madison, in center of town, in underpinning of Odd Fellows block; aluminum tablet stamped "294 AUGUSTA"	297.035
Anson, in front of station; top of rail	263.4

MADISON, EAST TO MADISON CENTER; THENCE NORTH VIA NORTH MADISON, TO SOLON.

Madison Center, at entrance to Lakewood Park (property of Somerset Traction Company), at forks of road, in granite foundation of farmhouse; bronze tablet stamped "363 AUGUSTA"	365.627
North Madison, 540 feet south of first four of "Twelve Corners," on summit of small hill, west side of road, in flint ledge; bronze tablet stamped "622 AUGUSTA"	624.508
Solon, New Caratunk Hotel (J. H. Grey, owner), in granite underpinning of west corner; bronze tablet stamped "403 AUGUSTA"	405.416

SOLON, WEST ALONG PUBLIC ROADS, TO EMBDEN CENTER.

	Feet.
Embden Center, at three corners of road, in front of old house, east side of road; bronze tablet stamped "474 AUGUSTA"	476.681

EMBDEN CENTER, SOUTH ALONG PUBLIC ROAD VIA NORTH ANSON, TO ANSON.

North Anson, opposite road forks, in east face of southeast corner of granite underpinning of building owned by F. W. Bunker; aluminum tablet stamped "293 AUGUSTA"	295.658
North Anson, in front of station; top of rail	315.4

BINGHAM QUADRANGLE.

SOLON, NORTH ALONG SOMERSET RAILWAY, TO BINGHAM.

Bingham, 3 miles south of, 7 miles north of Solon, right side of road, in bowlder; bronze tablet stamped "376 AUGUSTA"	378.216
Bingham, south end of east abutment of bridge over Austin Stream, bronze tablet stamped "367 AUGUSTA"	369.334
Bingham, in front of station; top of rail	351.8

BINGHAM, NORTH ALONG HIGHWAY, TO CARATUNK.

Bingham, 6.5 miles north of, in southeast corner of George Gordon's house; bronze tablet stamped "434 AUGUSTA"	436.434
Briggs Ferry, 600 feet north of (10.6 miles north of Bingham), ledge of rocks right side of road; bronze tablet stamped "451 AUGUSTA"	453.669
Caratunk, 1,000 feet south of post-office, right of road, in rock ledge; bronze tablet stamped "588 AUGUSTA"	590.384

BINGHAM, NORTHEAST ALONG SOMERSET RAILWAY, TO AUSTIN POND AND MOXIE POND.

Bingham, 5 miles northeast of, in rock wall at Chamberlain Hill; aluminum tablet stamped "1324 AUGUSTA" (bench mark on old line was unrecovered and elevation may be 3 feet too great)	1,326.534
Deadwater station, 3.7 feet east of southwest corner of tank house in granite underpinning; aluminum tablet stamped "1001 AUGUSTA"	1,003.500
Austin Pond, 100 feet east of main camp, 40 feet south of road to pond, in bowlder; aluminum tablet stamped "1190 AUGUSTA"	1,192.464

THE FORKS QUADRANGLE.

CARRITUNK, NORTH ALONG ROAD VIA THE FORKS, TO INDIAN POND.

The Forks, 2.5 miles south of, 5.2 miles north of Carritunk, 2,000 feet north of Ed. Morris's house, east side of road, in ledge of rocks; aluminum tablet stamped "576 AUGUSTA"	579.066
The Forks, east of bridge over Kennebec River, in granite abutment; bolt.	577.33
The Forks, 3 miles north of, west side of river, 300 feet south of Cold Stream, in rock ledge; aluminum tablet stamped "611 AUGUSTA"	614.090
The Forks, 10.2 miles north of, north bank of Chase Stream at mouth, in rock ledge; aluminum tablet stamped "757 AUGUSTA"	760.062
Indian Pond, east bank of river near southeast corner of dam, in rock ledge; aluminum tablet stamped "933 AUGUSTA"	936.013

THE FORKS, EAST TO LOWER (NORTH) END OF MOXIE POND; THENCE BY WATER LEVELS TO UPPER END.

The Forks, 3 miles east of, 320 feet east of Ed. Croto's house, south side of road, in large bowlder; aluminum tablet stamped "901 AUGUSTA"	903.261

	Feet.
Moxie Pond, north end of, at upper dam, in ledge at east side of Moxie Stream, 90 feet northeast of sluice gate; aluminum tablet stamped "959 AUGUSTA"	961.259
Moxie Pond, on west bank of Baker Stream, 50 feet east of railroad location, in ledge; aluminum tablet stamped "963 AUGUSTA"	966.060

BRASSUA LAKE QUADRANGLE.

INDIAN LAKE, NORTHEAST ALONG NORTH SIDE OF INDIAN POND, TO MOOSEHEAD.

Marrs Camp, north end of Indian Pond, 6.1 miles north of dam, at side of road, in rock ledge; aluminum tablet stamped "946 AUGUSTA"	948.300

MOOSEHEAD LAKE QUADRANGLE.

AT MOOSEHEAD.

Moosehead, southeast corner of east abutment of Canadian Pacific Railway bridge over east outlet of Moosehead Lake; aluminum tablet[a] stamped "1026 AUGUSTA"	1,028.154
Moosehead Lake, low water of October, 1903; surface	1,022.0
Moosehead Lake; high water (from information by proprietor of Outlet House)	1,028.7

Buckfield, Lewiston, Livermore, Norway, and Poland quadrangles.

ANDROSCOGGIN, CUMBERLAND, FRANKLIN, KENNEBEC, OXFORD, AND SAGADAHOC COUNTIES.

The elevations in the following list are based on bench marks of the double-rodded line of the Androscoggin River survey (water-resources branch United States Geological Survey), corrected in accord with the precise-level line of the topographic branch from Portland to Brunswick; and such of those bench marks as come in these quadrangles are included in the list.

The leveling was done in 1905 and 1906 by F. J. McMaugh.

LEWISTON QUADRANGLE.

LISBON FALLS, NORTHWEST ALONG MAINE CENTRAL RAILROAD, TO LEWISTON; THENCE NORTH TO KEENS MILLS.[b]

	Feet.
Lisbon Falls, in ledge about "10½ miles to Lewiston," side of river opposite lower end of Frosts Park; aluminum tablet (permanent bench mark No. 7)	111.231
Dingley farm, in large bowlder near north line, east of road about 300 feet; aluminum tablet (permanent bench mark No. 9)	265.527
Babbett & Googin dam, in high point of ledge below (this ledge is in bed of river and is an island during high water); aluminum tablet (permanent bench mark No. 10)	225.889

LEWISTON, NORTHEAST ALONG MAINE CENTRAL RAILROAD, TO LEEDS JUNCTION; THENCE SOUTH ALONG MAINE CENTRAL RAILROAD TO LISBON.

Lewiston, in south wall 50 feet north of west end of dam No. 4, Union Waterworks Company; point "S"	170.61
Lewiston, near end of railroad bridge over canal, southwest corner of Bates cotton mill, on foundation	148.400

---

[a] Elevation as brought by careful wye and water levels from Bangor, 1,028.223—a closure of 0.069, which can be thrown to water levels and the Penobscot and these corrected Kennebec levels from Portland can be considered as adjusted.

[b] Bench marks by water-resources branch.

	Feet.
Lewiston, in south face of southwest corner of post-office building; aluminum tablet stamped "AUGUSTA 196"	196.000
Lewiston, opposite baggage room at upper station; north rail	205.1
Lewiston, 2.8 miles north of, west side of track, in milestone "V 215;" aluminum tablet stamped "AUGUSTA 228"	227.852
Lewiston, 5.8 miles north of, in milestone "V 212;" aluminum tablet stamped "AUGUSTA 275"	275.312
Greene, in front of station; top of rail	302.0
Greene, 0.25 mile north of, in ledge; aluminum tablet stamped "293 AUGUSTA"	292.611
Leeds, in front of station; top of west rail	271.2
Leeds, 0.25 mile south of, in milestone "V 207;" aluminum tablet stamped "AUGUSTA 281"	281.194
Wales, in front of station, at crossing; top of rail	255.4
Leeds Junction, 3 miles south of, in east face of south wall of stone culvert; aluminum tablet stamped "AUGUSTA 254"	253.925
Sabattus, 330 feet east of station, north of track, in large bowlder; aluminum tablet stamped "AUGUSTA 266"	265.797
Sabattus, in front of station; top of rail	262.3
Webster woolen mills, Sabattus River; top of dam	215.8
Crowleys Junction, south end of west abutment	188.324
Crowleys Junction, north end, east abutment of railroad bridge; aluminum tablet stamped "189 AUGUSTA"	189.108
Crowleys, in front of station; top of east rail	191.2
Crowleys, 1.2 miles from junction, east wall, south end of granite abutment; at Moody Brook	186.683
Lisbon, in front of station; top of east rail	199.8
Lisbon, in front of office building of Farwell mills, 9 feet from northwest corner, 160 feet from junction of Main and Farwell streets; aluminum tablet stamped "185 AUGUSTA"	184.801

LEWISTON, SOUTHWEST ALONG THE GRAND TRUNK RAILWAY AND THE MAINE CENTRAL RAILROAD, TO RUMFORD JUNCTION.

Auburn, main track of Grand Trunk Railway; top of south rail	147.5
Rumford Junction, east of track, in milestone "Portland 32 miles, Vanceboro 221 miles;" aluminum tablet stamped "205 AUGUSTA"	205.210

POLAND QUADRANGLE.

RUMFORD JUNCTION, WEST TO POLAND; THENCE NORTH TO BUCKFIELD.

Lewiston Junction, 1 mile north of, north end of east abutment of Maine Central Railroad bridge; aluminum tablet stamped "280 AUGUSTA"	280.381
Elmwood Farm station; top of east rail	300.7
Poland Spring station; top of east rail	322.7
Poland, in front of station; top of rail	313.0
Poland, 1.7 miles north of station, 475 feet south of milepost, in west end of south wall of culvert; aluminum tablet stamped "284 AUGUSTA"	283.725
Mechanic Falls, in front of Maine Central Railroad station; top of west rail	303.4
Mechanic Falls, 1 mile north of, 420 feet north of railroad crossing, west end of south abutment of Maine Central Railroad bridge over Bog Brook; aluminum tablet stamped "267 AUGUSTA"	267.237
West Minot, main track in front of station; top of west rail	347.1
West Minot, 250 feet north of station, 50 feet south of highway bridge, 80 feet west of track, in rock ledge; aluminum tablet stamped "334 AUGUSTA"	334.356

	Feet.
East Hebron, 875 feet north of railroad crossing at station, 75 feet west of railroad track, in large bowlder; aluminum tablet stamped "348"	347.889

POLAND, SOUTHWEST TO WEST POLAND; THENCE NORTH VIA WATER LEVELING TO OXFORD; THENCE NORTH 3.6 MILES.

Poland, 2.2 miles from, 18 feet south of road and 750 feet east of road on east side of Tripp Pond; aluminum tablet stamped "343"	343.073
Tripp Pond, July 7, 1906, 11.30 a. m.; surface of water	305.5
West Poland, 1 mile west of, large bowlder 70 feet west of bridge over Potash Brook, 25 feet north of road, 360 feet west of house owned by G. D. Russell; aluminum tablet stamped "333"	332.977
Thompson Lake, July 9, 1906, 3.25 p. m.; surface of water	324.7
Oxford, ledge on Walker property, 100 feet west of northwest corner of school, 15 feet west of fence, 350 feet northwest of hotel; aluminum tablet stamped "348"	348.340
Oxford, 3.6 miles north of, 500 feet north of Gilman's crossing, 280 feet east of highway, on property of A. O. Lovering; aluminum tablet stamped "363"	363.348

SOUTH PARIS, EAST 5 MILES ALONG ROAD TO BUCKFIELD.

South Paris, 2.1 miles east of, west bank of Stony Brook, 25 feet north of bridge and 85 feet northeast of road forks, in ledge; aluminum tablet stamped "479"	478.783
South Paris, 4.9 miles east of, east of road, in pasture, and 130 feet southeast of four corners, in ledge; aluminum tablet stamped "1015"	1,014.906
Hebron, 40 feet southeast of corner of H. T. Glove livery barn, 60 feet northeast of center of highway, in rock ledge; aluminum tablet stamped "576"	576.129

NORWAY QUADRANGLE.

POINT 3.6 MILES NORTH OF OXFORD, NORTHWEST ALONG GRAND TRUNK RAILWAY, TO SOUTH PARIS.

South Paris, 1.4 miles south of, south end of east wall of granite arch culvert; aluminum tablet stamped "376"	376.407
South Paris, in front of station; top of west rail	392.2

BUCKFIELD QUADRANGLE.

POINT 5 MILES EAST OF SOUTH PARIS, NORTHEAST TO BUCKFIELD; THENCE EAST TO TURNER.

Buckfield, 2.6 miles west of, north side of road in angle of fence 330 feet west of house belonging to Greene Turner, in large bowlder; aluminum tablet stamped "826"	826.376
Buckfield, in second course from top, at east end of south abutment of railroad bridge over Twentymile River; aluminum tablet stamped "364"	364.259
Turner, top of coping at north end of dam, 2 feet south of face of retaining wall and 2.5 feet west of downstream face of dam; aluminum tablet stamped "303"	302.903

LIVERMORE QUADRANGLE.

TURNER, NORTHEAST TO KEENS MILLS.

Keenes Mills Cemetery, 0.25 mile north of, in orchard of Edward Pratt, 500 feet north of house, and 150 feet east of highway; aluminum tablet stamped "283"	283.111

Bethel, Fryeburg, Kezar Falls, and Rumford quadrangles.

CUMBERLAND, OXFORD, AND YORK COUNTIES.

The following elevations were determined by primary leveling extended from Cornish and Porter, on the precise-level line from Portland, and are based upon mean sea level. The single line, Lynchville to Bethel, closes 2.319 feet high on Androscoggin levels of the water-resources branch, corrected for a 1-foot error found at Turner Bridge.

The leveling was done as follows: In all four quadrangles by C. K. Alexander in 1908; in Fryeburg and Kezar Falls quadrangles by E. B. Hillegass in 1909.

KEZAR FALLS QUADRANGLE.

NEAR PORTER, NORTH ALONG HIGHWAYS, TO FRYEBURG.

	Feet.
Porter, 1.2 miles west of, north side of road, in rock; aluminum tablet stamped "399"	398.873
Porter, 3.3 miles northwest of, at fork of roads, in large rock, southwest corner of forks; aluminum tablet stamped "496"	495.815
Rands School, 6.5 miles northwest of Porter, west of road, opposite schoolhouse, in rock ledge; aluminum tablet stamped "875"	875.374
Brownfield station, 3.8 miles southwest of, in large rock north of road; aluminum tablet stamped "515"	514.969
Brownfield, 3 miles west of station, at southeast corner of road crossing, on granite post; paint mark "481.6"	481.69
Fryeburg, 3.9 miles south of, on west side of road, in large rock; aluminum tablet stamped "493"	493.458

CORNISH, NORTHWEST ALONG MAINE CENTRAL RAILROAD, TO FRYEBURG (MEAN OF TWO RUNNINGS).

Cornish station, on Maine Central Railroad; spike in east end of crossing planks, marked "300"	299.98
West Baldwin, 600 feet east of station; spike in east end of railroad-crossing planks, marked "346"	345.52
Bridgton Junction, 1 mile southeast of, at northeast side of railroad, in top face of culvert stone; aluminum tablet stamped "356"	355.538
Hiram, 2 miles west of, south side of railroad, in top face of southeast abutment of small bridge; aluminum tablet stamped "398"	396.596
East Brownfield (Brownfield station), at southeast corner of station, in top face of large embedded rock; aluminum tablet stamped "400"	398.935
East Brownfield (Brownfield station), 3 miles northwest of, at crossing of brook, in top face of south side of east abutment of bridge; aluminum tablet stamped "386"	384.820

FRYEBURG QUADRANGLE.

FRYEBURG, NORTHEAST ALONG HIGHWAYS, TO WEST BRIDGTON; THENCE NORTHWEST TO LOVELL.

Fryeburg, at corner of Main and Portland streets, in east face of monument; aluminum tablet stamped "429"	429.245
Fryeburg, 2.7 miles northeast of, south of road in large rock; aluminum tablet stamped "478"	478.300

	Feet.
East Fryeburg, at northeast corner of road crossing, in southwest corner of Mount Pleasant Band hall; aluminum tablet stamped "486"	486.606
West Bridgton, in southwest corner of schoolhouse, north of road; aluminum tablet stamped "516"	515.994
Lovell, 2.9 miles southeast of, in southeast corner of Black Mountain schoolhouse; aluminum tablet stamped "549"	549.226
Lovell, 0.2 mile north of road forks, in front of C. K. Chapman's residence, in rock of stone wall; aluminum tablet stamped "439"	439.425

LOVELL, NORTHEAST AND NORTH ALONG HIGHWAYS, TO LYNCHVILLE.

Sweden Corner, at northwest corner of road crossing, in southeast corner of stone wall of O. P. Saunders's residence; aluminum tablet stamped "692"	692.067
East Sweden, in southeast corner of stone wall of schoolhouse; aluminum tablet stamped "568"	568.263
North Waterford, 4 miles south of, in southeast corner of stone wall of schoolhouse; aluminum tablet stamped "963"	963.723
North Waterford, 2.7 miles southeast of, west of road, opposite John Tubb's residence, in large rock; aluminum tablet stamped "797"	797.533
North Waterford, in stone wall at northwest corner of Congregational Church; aluminum tablet stamped "650"	650.884
Lynchville, on foundation stone on north side at east end of bridge over Crooked River; paint mark "555.7"	554.122

FRYEBURG, NORTH ALONG HIGHWAYS, TO NORTH FRYEBURG; THENCE EAST TO LOVELL; THENCE NORTH TO EAST STONEHAM.

Fryeburg Center, opposite Odd Fellows' hall, in face of large bowlder at northwest corner of road forks; aluminum tablet stamped "438"	437.797
North Fryeburg, in top face of door stone of Universalist Chapel; aluminum tablet stamped "388"	388.114
North Fryeburg, at northwest corner of Harry Hutchin's general store, on top of stone post; chisel mark "387"	386.00
Harbor, at Iron Bridge, in top face of stone of northwest abutment; aluminum tablet stamped "381"	380.870
Lovell, 0.2 mile north of road forks, in front of C. K. Chapman's residence, in rock of stone wall; aluminum tablet stamped "440"	439.425
Center Lovell, 300 feet south of schoolhouse, east of road, in top face of large bowlder; aluminum tablet stamped "530"	529.644
Center Lovell, 4 miles north of, in front of Stephen Kimball's residence, west of road, in top face of bowlder embedded in ground; aluminum tablet stamped "725"	724.478
East Stoneham, opposite to Knights of Pythias hall, in large bowlder; aluminum tablet stamped "629"	628.553

HARBOR, NORTHWEST ALONG HIGHWAY 2.8 MILES (SINGLE-SPUR LINE).

Harbor, 2.8 miles northwest of, west of road opposite O. P. Stevens's residence, in rock; aluminum tablet stamped "423"	423.187

BETHEL QUADRANGLE.

LYNCHVILLE, NORTH ALONG HIGHWAY, TO BETHEL.[a]

	Feet.
Lynchville, 2.5 miles north of, 275 feet north of bridge over Crooked River, in rock ledge at west side of road; aluminum tablet stamped "577"	575.441
Albany, 1.3 miles north of, on rock at northwest corner of road forks; paint mark "654.6"	Feet. 653.10
Sango Pond, near south end of, west of road, in top face of large bowlder; aluminum tablet stamped "667"	665.580
Bethel, at foot of Mill Hill, on rock at northeast corner of street; chisel mark "659"	657.32
North Bethel, 3 miles south of, between Bethel and Maysville, in west end of south abutment of covered highway bridge over Androscoggin River; aluminum tablet (water-resources branch bench mark No. 27)	649.885

RUMFORD QUADRANGLE.

LYNCHVILLE, NORTH ALONG HIGHWAY, TO BETHEL.[a]

Albany, 0.8 mile south of town house, west of road, near Carter Grover's residence, in rock ledge; aluminum tablet stamped "647"	645.630
Albany Corners or Town House, on rock at southwest corner of crossroads; chisel mark "651"	649.71

Belfast, Castine, and Rockland quadrangles.

KNOX AND WALDO COUNTIES.

The elevations in the following list are based on an aluminum tablet in the post-office and custom-house building at Bangor, the elevation of which is accepted as 23.725 feet above mean sea level, as derived from a tide gage at Bucksport.

The leveling of this list was begun at a bench mark at North Searsport, described in another list republished from Bulletin 185 (p. 20), and was double rodded to West Rockport. The leveling was done in 1904 by F. J. McMaugh.

BELFAST QUADRANGLE.

SWANVILLE, SOUTH ALONG HIGHWAY, TO BELFAST.

	Feet.
Swanville, 3 miles south of, in granite ledge at left of road; aluminum tablet stamped "216"	215.852
Belfast, in water table on Church street front of court-house; aluminum tablet stamped "102"	102.368

DUCKTRAP RIVER, SOUTHWEST ALONG HIGHWAY VIA LINCOLN, TO CAMDEN.

Northport, 4.1 miles south of, 100 feet south of L. D. Ames's house, 65 feet west of road; aluminum tablet stamped "34"	34.059
Lincolnville Beach, north end of bridge over inlet; mark on stone coping.	8.68
Lincolnville, 2.4 miles south of, in ledge at top of hill, 25 feet south of wood road west, 600 feet south of house; aluminum tablet stamped "194"	194.012

---

[a] Portion of a line closing 2,319 feet high upon Androscoggin levels of water-resources branch corrected for a 1-foot error found at Turner Bridge.

CASTINE QUADRANGLE.

BELFAST, SOUTH ALONG HIGHWAY, TO DUCKTRAP RIVER.

	Feet.
Belfast, 2.5 miles south of court-house, coping top of dam at Little River pumping station	22.7
East Northport, 250 feet southeast of junction of roads at Browns Corners, at left of road, on ledge; aluminum tablet stamped "50"	50.065
Northport, Saturday Cove, at junction of roads, 15.5 feet southwest of pump, 35 feet northeast of northeast corner of drab-colored building, in ledge; aluminum tablet stamped "120"	119.789

ROCKLAND QUADRANGLE.

CAMDEN, SOUTHWEST TO WEST ROCKPORT.

Camden, Camden National Bank, in granite pier, Elm street front; aluminum tablet stamped "36"	36.044
West Rockport, 2 feet west of signboard; mark on stone monument	220.28
West Rockport, in large bowlder southeast side of road to Warren, 500 feet southwest of signboard, 100 feet southwest of house, 25 feet east of center of road; aluminum tablet stamped "228"	227.980

WEST ROCKPORT, SOUTH ALONG HIGHWAY, TO ROCKLAND; THENCE SOUTHWEST TO THOMASTON; THENCE NORTHWEST TO WARREN; THENCE NORTHEAST TO WEST ROCKPORT.

Rockland, 3.8 miles north of, in ledge west of road along west shore of Chickawaukie Pond, 80 feet south of telephone pole marked "U. S." with arrow pointing toward tablet; aluminum tablet stamped "142"	142.029
Rockland, in water table at south side of post-office building near southwest corner; aluminum tablet stamped "35"	34.978
Thomaston, 110 feet south of Main street and 45 feet south of end of iron fence on west side of warden's yard at state prison; mark on top of granite monument	137.83
Thomaston, in first course of west pier of old gateway dated "1824" in wall of state prison grounds, opposite fire station house; aluminum tablet stamped "142"	142.293
Warren, 0.2 mile south of road forks near; in ledge at left of road; aluminum tablet stamped "131"	130.925
Warren, 3.9 miles northeast of, in ledge at junction of roads 50 feet south of main road; aluminum tablet stamped "219"	218.887

Bangor, Bluehill, Bucksport, Ellsworth, Mount Desert, Orland, and Orono quadrangles.

HANCOCK, PENOBSCOT, AND WALDO COUNTIES.

The elevations in the following list are based on an aluminum tablet in the post-office and custom-house building at Bangor, stamped "23 BANGOR 1899," the elevation of which is accepted as 23.725 feet above mean sea level, as determined by an adjusted circuit from Bucksport, where tidal observations on the Penobscot River were taken during two lunar months in August and September, 1899. The standard bench marks in this area, which were published in Bulletin No. 185, are included in this list.

The leveling was done as follows: In Bucksport quadrangle by Robert Coe and J. W. Edgerly in 1899, and by F. J. McMaugh in 1904; in Bangor quadrangle by J. W. Edgerly in 1900; in Orono quadrangle by J. W. Edgerly in 1900, and by F. J. McMaugh in 1904; in Orland quadrangle by Robert Coe in 1899, and by A. S. Havens in 1901; in Bluehill and Mount Desert quadrangles by A. S. Havens in 1901; and in Ellsworth quadrangle by C. K. Alexander in 1908.

BUCKSPORT QUADRANGLE.

BANGOR, SOUTH ALONG BUCKSPORT BRANCH MAINE CENTRAL RAILROAD, TO BUCKSPORT.

	Feet.
South Orrington, in foundation of Methodist Church, in middle of south face of third stone from southwest corner; aluminum tablet stamped "61 BANGOR 1899"	61.440
North Bucksport, 0.7 mile south of, 8 feet southwest of milepost "Bucksport 6 miles, Portland 150 miles," point of gray bowlder; chisel mark	103.38
Bucksport Center, 0.9 mile south of, 10 feet south of milepost "Bucksport 4 miles, Portland 152 miles," point of blue bowlder; chisel mark	115.15
Bucksport, on lowest step of side wall on left side of stone steps to Buck Memorial Library, in front face of coping; aluminum tablet stamped "43 BANGOR 1899"	43.148

BUCKSPORT, WEST ALONG HIGHWAY VIA PROSPECT, TO NORTH SEARSPORT.

Prospect, 0.25 mile south of, residence of J. R. Killman, in south face of brick, second above foundation and third from southwest corner; aluminum tablet stamped "77 BANGOR 1899"	76.710
Prospect, 3 miles west of, 80 feet east of four corners crossroads on Browns Hill, north of road, on large gray bowlder; chisel mark	318.68
North Searsport, near road forks, 20 feet southwest of signboards "Frankfort 7 miles, Belfast 10 miles, Swanville 3 miles," "Searsport 7 miles, Monroe 5 miles," in small gray bowlder; aluminum tablet stamped "393 BANGOR 1899"	392.663

NORTH SEARSPORT, NORTH ALONG HIGHWAY VIA WEST WINTERPORT, TO NORTH NEWBURG.

West Winterport, residence of J. W. Hobbs, in front face of top front doorstep; aluminum tablet stamped "162 BANGOR 1899"	161.650
Ellingwoods Corner, 0.25 mile north of, brick residence of Stephen L. Perkins, center of capstone of cellar window at south end; aluminum tablet stamped "387 BANGOR 1899"	386.814

NORTH SEARSPORT, SOUTHWEST ALONG HIGHWAY, TO SWANVILLE.

Swanville, 150 feet south of Nickerson & Quinn's store, west of road, in bowlder; aluminum tablet stamped "209"	209.410

BANGOR QUADRANGLE.

NORTH NEWBURG, NORTHEAST, TO HERMON CENTER; THENCE EAST ALONG HIGHWAY TO BANGOR.

North Newburg, at crossroads, 90 feet west of signboards "Winterport 11 miles, Carmel 4 miles, Bangor 11 miles, North Dixmont 9 miles," in ledge; aluminum tablet stamped "180 BANGOR 1899"	180.389
Bangor, at south end of post-office and custom-house, about middle of first course of stone above the top of landing steps; aluminum tablet stamped "23 BANGOR 1899"	23.725

HERMON CENTER, NORTHWEST ALONG HIGHWAY VIA LEVANT, TO SOUTH CORINTH; THENCE EAST TO OLDTOWN.

	Feet.
Snow Corner, 100 feet northeast of crossroads, south of highway, at rear of post-office, in root of fir tree; nail	168.90
Levant, west face of southeast corner stone of underpinning of post-office; aluminum tablet stamped "143 BANGOR"	142.988
Kenduskeag, in front of residence of Dr. J. B. Benjamine, east of road, in root of 3-foot elm tree; nail	137.05
South Corinth, west of road, about 1,600 feet north of crossroads, in ledge on Cushman Hill; bronze tablet stamped "296 BANGOR"	295.935
Hudson, in east face of underpinning on east side of Baptist Church; aluminum tablet stamped "151 BANGOR"	151.363
West Oldtown, 300 feet west of corner, 36 feet north of road, southeast face of large bowlder; bronze tablet stamped "126 BANGOR"	125.678

ELLSWORTH QUADRANGLE.

ELLSWORTH, NORTH ALONG MAINE CENTRAL RAILROAD AND HIGHWAY, TO TILDEN; THENCE EAST TO WALTHAM.

Ellsworth, in foundation of Ellsworth Trust Company's bank building; aluminum tablet stamped "24"	23.993
Ellsworth Falls, 2.6 miles northwest of, on Mariaville road, 150 feet east of road in field, in top face of large bowlder; aluminum tablet stamped "145"	145.005
Lakewood, 0.1 mile south of road corner, 30 feet west of road, in rock ledge; aluminum tablet stamped "181"	181.012
Lakewood, 3.1 miles north of, at forks of old and new roads, east of road, 100 feet south of corner, in top face of large bowlder; aluminum tablet stamped "204"	203.891
Tilden, at southeast corner of road forks, in top face of large bowlder; aluminum tablet stamped "231"	230.938
Waltham, 1 mile north of post-office, 0.1 mile west of crossroads, north of road, in top face of large bowlder; aluminum tablet stamped "414"	414.243
Waltham, at summit of hill, 250 feet north of graveyard, opposite schoolhouse, on north side of old cellar, in top face of buried rock; aluminum tablet stamped "480" (triangulation station)	480.285

ELLSWORTH, EAST ALONG MAINE CENTRAL RAILROAD, TO FRANKLIN; THENCE NORTH AND WEST TO WALTHAM.

Washington Junction, 0.25 mile east of station, on south side of Washington County Railway, in top face of large bowlder; aluminum tablet stamped "172"	172.354
Washington Junction, 5 miles east of, at stream crossing known as "Stone Horse," south of railroad track in east end of abutment of railroad bridge; aluminum tablet stamped "121"	121.547
Franklin, 1 mile west of, 250 feet north of railroad crossing, west of road, in top face of large bowlder; aluminum tablet stamped "88"	88.473
Eastbrook Corners, 3 miles south of, near crossing of outlet of Georges Pond, private road running west, west of road just south of road forks, in top face of large bowlder; aluminum tablet stamped "168"	168.063
Eastbrook Corners, at southwest side of, in top face of large bowlder; aluminum tablet stamped "169"	169.180

WALTHAM, SOUTHWEST TO A POINT 2 MILES NORTH OF ELLSWORTH FALLS.

Waltham, 1 mile south of post-office, 0.05 mile north of road forks, east of road, in top face of large bowlder; aluminum tablet stamped "176"	176.007

	Feet.
Waltham, 4 miles south of, near small summit (lower elevations toward south), in top face of large bowlder west of road; aluminum tablet stamped "168"	167.787
Ellsworth Falls, 4.5 miles north of, on rock lying west of road; chisel mark "107"	106.41
Ellsworth Falls, 3.5 miles north of, at southwest corner of No. 8 plantation, 0.5 mile south of schoolhouse, east of road, in top face of large bowlder; aluminum tablet stamped "125"	124.555

ORONO QUADRANGLE.

MILFORD, NORTHEAST ALONG HIGHWAY 7 MILES (SPUR LINE).

Milford, 7 miles northeast of, near highway bridge over Birch Stream on Milford-Greenfield road, 80 feet south of center of and 28 feet east of center of traveled highway, in ledge; bronze tablet stamped "130 BANGOR"	130.586

OLDTOWN, SOUTHWEST ALONG HIGHWAY AND MAINE CENTRAL RAILROAD, TO VEAZIE.

Oldtown, St. James Episcopal Church, corner Maine and Middle streets, east end of north face; aluminum tablet stamped "108 BANGOR"	108.106
Orono, University of Maine, in west face of coping stone of Wingate hall; aluminum tablet stamped "115 BANGOR"	115.529

VEAZIE, SOUTHEAST ALONG HIGHWAY, TO EAST EDDINGTON.

East Eddington, Universalist Church, in northwest corner stone; bronze tablet stamped "193 BANGOR"	193.426

EAST EDDINGTON TO CLIFTON (SINGLE SPUR LINE).

Clifton, 9 feet east of southeast corner of Free Baptist Church, in ledge; ¾-inch iron bolt	285.338

EAST EDDINGTON, SOUTH TO EAST HOLDEN; THENCE WEST ALONG MAINE CENTRAL RAILROAD, TO BANGOR.

Harts Corners, in east face of underpinning of Holden townhouse, 11 feet south of entrance; aluminum tablet stamped "296 BANGOR"	298.210

OLDTOWN, NORTH ALONG MAINE CENTRAL RAILROAD, TO COSTIGAN.

Milford, in front of station; top of rail	129.2
Oldtown, 3.1 miles north of, east side of track, in ledge; aluminum tablet stamped "133 BANGOR"	132.562

ORLAND QUADRANGLE.

BUCKSPORT, VIA ORLAND, EAST ORLAND, AND WEST ELLSWORTH, TO ELLSWORTH.

East Orland, 960 feet east of bridge at road forks, 70 feet to left of road, on side of bowlder; aluminum tablet stamped "168 B 1899"	168.059
West Ellsworth, 1,150 feet west of road forks, 40 feet to left of road, bowlder in field; aluminum tablet stamped "275 BANGOR 1899"	275.497

ELLSWORTH, NORTHWEST OVER WAGON ROAD, TO EAST HOLDEN.

Nicolin, 50 feet to left of Ellsworth-Bangor road and 10 feet to right of road from Nicolin railroad station to Branch Pond, on gray rock; aluminum tablet stamped "446 BANGOR"	446.475
Dedham, 1.5 miles south of Lake House railroad station, in west side of big bowlder; aluminum tablet[a] stamped "287 BANGOR"	286.545

---

[a] An adjustment of nearly 2 feet is made in line between here and East Holden.

ORLAND, NORTH TO NEAR EAST BUCKSPORT (SINGLE SPUR LINE).

	Feet.
East Bucksport, 3 miles south of, northeast corner stone of East Bucksport Church; aluminum tablet stamped "186 BANGOR"	186.119

BLUEHILL QUADRANGLE.

EAST ORLAND, SOUTHEAST ALONG HIGHWAY, TO BLUEHILL; THENCE NORTHEAST TO SURRY.

North Bluehill, 660 feet west of crossroads, 30 feet north of road running west, in bowlder; bronze tablet stamped "337 BANGOR 1901"	336.809
Bluehill, 125 feet east of northwest-southeast road, 75 feet south of public wharf, in face of rock ledge; bronze tablet stamped "15 BANGOR 1901"	14.981
Surry, 1.25 miles south of, 15 feet west of road, opposite house on right, about 250 feet south of road to left, in bowlder; chisel mark "D"	174.19

MOUNT DESERT QUADRANGLE.

FROM SURRY NORTHEAST TO ELLSWORTH.

Surry, 0.5 mile east of, 800 feet east of Surry townhall, 15 feet to right of road, in rock ledge; bronze tablet stamped "88 BANGOR 1901"	88.874

Lincoln, Mattawamkeag, Millinocket, Passadumkeag, and Winn quadrangles.

PENOBSCOT COUNTY.

The elevations along Penobscot River in the following list are based on an aluminum tablet in the post-office and custom-house building at Bangor, stamped "23 BANGOR 1899." The elevation of this bench mark is accepted as 23.725 feet above mean sea level. A double-rodded line was run, beginning at a bench mark at Oldtown, reported in another list (p. 22) republished from Bulletin 185. From Millinocket, water and spirit levels were extended by the Great Northern Paper Company and the water-resources branch of the United States Geological Survey to Moosehead, where a junction was made with the Kennebec levels. The extended elevations were found to be in such close agreement with the Kennebec levels, as corrected in 1906 to reliable mean sea-level datum at Portland, that no adjustment has been made in determining the elevations of this list.

The leveling was done in 1904 by F. J. McMaugh.

PASSADUMKEAG QUADRANGLE.

COSTIGAN, NORTH ALONG MAINE CENTRAL RAILROAD, TO ENFIELD.

	Feet.
Costigan, 215 feet north of station, railroad bridge, east end of south abutment; aluminum tablet stamped "115"	114.979
Greenbush, 1.6 miles south of, in milestone marked "Vanceboro 93 miles, Portland 158 miles;" aluminum tablet stamped "122"	121.999
Greenbush station; top of west rail	133.5
Greenbush, 1.4 miles north of, east side of track, in milestone marked "Vanceboro 90 miles, Portland 161 miles;" aluminum tablet stamped "145"	144.985
Olamon, in front of station; top of east rail	131.3
Olamon, 0.7 mile north of, east side of track, in milestone marked "Vanceboro 87 miles, Portland 164 miles;" aluminum tablet stamped "144"	143.957

	Feet.
Passadumkeag, railroad bridge over Passadumkeag River, east end of south abutment; aluminum tablet stamped "140"	139. 528
Enfield, 1.9 miles south of, in milestone marked "Vanceboro 81 miles, Portland 170 miles;" aluminum tablet stamped "185"	185. 039

LINCOLN QUADRANGLE.

ENFIELD NORTHEAST ALONG MAINE CENTRAL RAILROAD, TO LINCOLN CENTER.

Enfield, in front of station; top of east rail	202. 9
Enfield, 1 mile north of, in milestone marked "Vanceboro 78 miles, Portland 173 miles;" aluminum tablet stamped "221"	220. 984
South Lincoln, 1.1 miles southeast of, 4 miles north of Enfield, in milestone marked "Vanceboro 75 miles, Portland 176 miles;" aluminum tablet stamped "242"	241. 989
South Lincoln, in front of station; top of rail	238. 5
South Lincoln, 1.9 miles northeast of, east side of track, in milestone marked "Vanceboro 72 miles, Portland 179 miles;" aluminum tablet stamped "241"	240. 975
Lincoln, in front of station; top of west rail	216. 3
Lincoln, 0.7 mile north of, in milestone marked "Vanceboro 69 miles, Portland 182 miles;" aluminum tablet stamped "223"	222. 970

WINN QUADRANGLE.

LINCOLN CENTER, NORTHEAST ALONG MAINE CENTRAL RAILROAD, TO MATTAWAMKEAG.

Lincoln Center, in front of station; top of east rail	179. 0
North Lincoln, in milestone marked "Vanceboro 66 miles, Portland 185 miles;" aluminum tablet stamped "225"	224. 958
North Lincoln, in front of station; top of east rail	210. 2
North Lincoln, 3 miles northeast of, in milestone marked "Vanceboro 63 miles, Portland 188 miles;" aluminum tablet stamped "229"	228. 977
Winn, 1.2 miles southwest of, in milestone marked "Vanceboro 60 miles, Portland 191 miles;" aluminum tablet stamped "199"	199. 142
Winn, in front of station; top of east rail	212. 1

MATTAWAMKEAG QUADRANGLE.

MATTAWAMKEAG, NORTHWEST ALONG HIGHWAY, TO MEDWAY.

Mattawamkeag, in front of station; top of east rail	217. 8
Mattawamkeag, 0.2 mile north of, railroad bridge over Mattawamkeag River, east end of south abutment; aluminum tablet stamped "213"	212. 692
Mattawamkeag, 3.1 miles northwest of, east side of road to Jordan's mill, 260 feet north of junction with main road to Medway, large bowlder; aluminum tablet stamped "217"	217. 013
Mattawamkeag, 6.64 miles northwest of, west of road in clearing, 120 feet northeast of small shack, 160 feet east of log cabin, large bowlder; aluminum tablet stamped "320"	320. 184
Medway, 2.36 miles southeast of, west of road, 250 feet northwest of Clarke Lakeman's house, in ledge; aluminum tablet stamped '256"	256. 261

MILLINOCKET QUADRANGLE.

MEDWAY, NORTHWEST ALONG HIGHWAY, TO MILLINOCKET; THENCE SOUTHWEST, ALONG BANGOR AND AROOSTOOK RAILROAD, TO TWIN LAKES.

	Feet.
Medway, 0.27 mile west of ferry, on land of A. T. Reed, 50 feet east of road and 120 feet west of his house, in ledge; aluminum tablet stamped "279".	278. 911
Medway, 5.30 miles northwest of, 745 feet north of Charles T. Powell's house, 35 feet west of road, in bowlder; aluminum tablet stamped "306"..	305. 598
Millinocket Congregational Church, southeast corner of granite underpinning of tower; aluminum tablet stamped "384"	383. 992
Millinocket, in front of station; top of south rail	363. 3
Twin Lake dam (4.87 miles southwest of Millinocket), top of north pier at 24-foot gate opening; aluminum tablet stamped "495"	494. 562
Twin Lake dam, 1 mile east of Norcross, 80 feet south of dam, south of track, in large bowlder; copper bolt[a]	503. 43

Cherryfield quadrangle.

WASHINGTON COUNTY.

The elevations published in the following list are based on a bronze tablet at Millbridge, one-third mile southeast of post-office, in brown rock ledge on shore of harbor and 70 feet south of Sawyer's sardine wharf, stamped "7 B 1901," the elevation of which is 7.247 feet above mean sea level, as determined by connection with tide gage at Millbridge upon which high and low water readings were made daily during a period of one lunar month in July and August, 1901. The standard bench marks depending on this datum are referred through sea-level connections to the central datum at Bangor and are stamped with the letter "B" in addition to the figures of elevation and year. The leveling was done in 1901 by A. S. Havens.

MILLBRIDGE, ALONG HIGHWAYS VIA STEUBEN AND UNIONVILLE, TO CHERRYFIELD.

	Feet.
Millbridge, at end of Sawyer's sardine wharf, 10 feet from southwest corner; ringbolt through stringpiece	9. 56
Millbridge, 70 feet south of Sawyer's sardine wharf, in brown rock ledge on shore of harbor; bronze tablet stamped "7 B 1901"	7. 247
Millbridge, northeast corner of Main street and road to sardine wharf, on granite post; chisel mark	33. 24
Millbridge, southeast corner of Main street and Harrington road (signboard reads "Harrington 8 miles"), on granite post; chisel mark	48. 57
Steuben, at northwest corner of road intersection, on granite post (signboard reads "Gouldsboro 5 miles, Unionville 6 miles"); chisel mark....	46. 32
Cherryfield, 0.1 mile south of station, in northwest corner of junction of east-west road (signboard reads "Franklin 18 miles, Harrington 6 miles"), in face of rock ledge; bronze tablet stamped "44 B 1901"	44. 444

---

[a] Used by Mr. Ferguson, of the Great Northern Paper Company, Millinocket, as basis of work in the vicinity of Twin Lakes.

CHERRYFIELD, EAST TO HARRINGTON; THENCE NORTHEAST TO EPPING; THENCE WEST VIA SCHOODIC LAKE TO GREAT FALLS BRANCH SCHOODIC BROOK; THENCE SOUTHEAST TO CHERRYFIELD.

	Feet.
Harrington, 0.6 mile west of, at east end of new steel bridge over Harrington River, on south side of abutment; bronze tablet stamped "B 14 1901"	14.044
Epping, 1.25 miles west of, 60 feet west of crossroad from Columbia railroad station, 10 feet south of road, on bowlder; bronze tablet stamped "226 B 1901"	226.117
Epping, 3.5 miles west of, East Base Coast and Geodetic Survey base line station, on granite monument; bronze bolt	254.187
Cherryfield, 9.3 miles northwest of, on Denlois road, 1 mile southeast of road fork to Epping, 40 feet north of bridge over Great Falls Branch Schoodic Brook, 5 feet west of road, in face of large gray bowlder; bronze tablet stamped "151 B 1901"	151.128

Cutler and Eastport quadrangles.

WASHINGTON COUNTY.

The elevations in the following list depend on the height of a tidal bench mark described as "a hole drilled on Gun Rock, Lubec Channel," the height of which was determined by the United States Engineer Corps in 1878 from fifty-six consecutive day and night observations.[a]

The circuit on Eastport quadrangle was closed through water levels between Eastport and Lubec.

The leveling was done in 1907 by H. M. Gilman.

EASTPORT QUADRANGLE.

LUBEC, SOUTHWEST ALONG HIGHWAYS, TO WHITING; THENCE NORTHWEST TO DENNYSVILLE; THENCE EAST VIA WEST PEMBROKE TO EASTPORT.

	Feet.
Lubec, Lubec Channel, in top of rounded rock, known as Gun Rock, in base of extremity of breakwater, established by United States Engineer Corps in 1878 (observations by Captain Trott, of Lubec); drill hole	8.291
Lubec, northeast of road, in southwest face of foundation of Disciples Church; aluminum tablet stamped "118, 1907"	118.852
West Lubec, 1.2 miles east of, 500 feet west of small wooden bridge in hollow, 250 feet north of road, in rock ledge; aluminum tablet stamped "45, 1907"	46.082
Whiting, 3.4 miles east of, 2 miles southwest of West Lubec, south edge of road, 250 feet south of John Craig's house, in rock ledge; aluminum tablet stamped "96, 1907"	97.076
Whiting, 0.3 mile east of road forks, 5 feet north of road at edge of stream in hollow, in top surface of rock ledge; aluminum tablet stamped "20, 1907"	20.940
Whiting, 2.5 miles north of, 80 feet south of large iron bridge east of road in top of rock ledge; aluminum tablet stamped "20, 1907"	20.322
Dennysville, 3.5 miles south of, 30 feet west of road, 80 feet northeast of house at bend in road, in top face of rock ledge; aluminum tablet stamped "147, 1907"	147.671

---

[a] See Report of Chief of Engineers for 1879, Appendix A, pp. 280-282.

	Feet.
Dennysville, 660 feet southeast of bridge over Dennys River, near top of hill by schoolhouse, in top face of rock ledge southwest of road; aluminum tablet stamped "86, 1907"	87.005
Dennysville, 3 miles north of, 3.2 miles southwest of Pembroke, opposite schoolhouse south of road, in rock ledge north of road; aluminum tablet stamped "141, 1907"	141.965
West Pembroke, 100 feet north of Union League Church, south of road, in rock ledge; aluminum tablet stamped "68, 1907"	68.369
Pembroke, 4 miles east of, 6.7 miles northwest of Eastport, 500 feet southeast of road forks, on opposite side of road from C. H. Leones' house, in top of rock ledge west of road; aluminum tablet stamped "62, 1907"	62.975
Eastport, 3.5 miles northwest of, 500 feet east of toll bridge, in west end of stone watering trough at top of hill; aluminum tablet stamped "62, 1907"	62.657
Eastport, corner of Washington and Water streets, in west face of southwest corner of granite belting course of custom-house and post-office; aluminum tablet stamped "40, 1907"	40.920

CUTLER QUADRANGLE.

WEST LUBEC, SOUTHWEST ALONG HIGHWAYS TO CUTLER; THENCE NORTH TO WHITING.

West Lubec, 3.2 miles south of, 500 feet west of stream crossing, in front of Stewart McFadden's house, 5 feet south of road, in rock ledge; aluminum tablet stamped "22, 1907"	22.440
West Lubec, 6.3 miles southwest of, 7.5 miles northeast of Cutler, at end of T road north, north side of road, in top of rock ledge; aluminum tablet stamped "31, 1907"	31.600
Cutler, 3 miles northeast of, 110 feet north of road, 80 feet west of small house on hill, in rock ledge; aluminum tablet stamped "136, 1907"	136.226
Cutler, 600 feet west of road forks, north of road, in front of Samuel Maker's house, in top face of rock ledge; aluminum tablet stamped "24, 1907"	24.835
Cutler, 3.2 miles north of, 1,200 feet south of stream crossing, in top of large rock 5 feet west of road; aluminum tablet stamped "156, 1907"	156.536
Cutler, 6.5 miles north of, 4 miles south of Whiting, 0.4 mile north of Springbrook crossing, 10 feet west of road, in top face of rock; aluminum tablet stamped "109, 1907"	110.082

Augusta, Bath, Bethel, Buckfield, Dixfield, Freeport, Gardiner, Lewiston, Livermore, and Rumford quadrangles.

ANDROSCOGGIN, CUMBERLAND, FRANKLIN, KENNEBEC, OXFORD, AND SAGADAHOC COUNTIES.

The elevations in the following list of bench marks established by the water-resources branch of the United States Geological Survey under the general direction of H. K. Barrows, district engineer, were determined by a double-rodded primary-level line extended from Augusta along the Maine Central Railroad to Brunswick; thence up Androscoggin River along railroad and highways to Errol, N. H. The New Hampshire elevations are not included in this list. The leveling was begun at a gage bench mark at Hallowell, Me., the stated elevation of which proved later to be unreliable. The elevations now given are based on mean sea level determined by gage record at

Portland, and accord with elevations determined by precise leveling of the topographic branch of the Geological Survey, from Portland to Brunswick, as given in another list (pp. 8–9). At Turner Bridge, 39.7 miles from Brunswick, a 1-foot error was discovered by certain checked relevelings, and the remainder of the line was corrected by that amount; but there yet remains an outstanding discrepancy of 2.3 feet between this line and levels of the topographic branch at Bethel, an error that may be located by future work.

In running the base levels of 1905, from Hallowell via Brunswick to Livermore Falls, H. S. Boardman was chief of party. In running the base levels of 1906, from Livermore Falls to Errol, N. H., C. Robert Adams and T. W. Norcross were chiefs of party.

Primary leveling by the water-resources branch extended from Augusta.

FROM AUGUSTA, SOUTHWEST ALONG MAINE CENTRAL RAILROAD AND HIGHWAY, TO BRUNSWICK (DOUBLE-RODDED LINE).

Distance in miles.	Location and description of bench mark.	Elevation in feet.
	AUGUSTA QUADRANGLE.	
....	Augusta, northwest corner of west wing of statehouse; aluminum tablet	152.950
....	Hallowell, southwest corner of cotton mill on Water street; horizontal chisel mark (Coast and Geodetic Survey bench mark No. 2)..........	27.091
	GARDINER QUADRANGLE.	
....	Gardiner, opposite post-office, in northeast corner of Savings Institution Building; aluminum tablet..........	25.417
....	Richmond, building used for post-office, in left side of entrance; aluminum tablet..........	30.935
....	Bowdoinham, in west abutment of highway bridge over Cathance River; aluminum tablet..........	7.117
	BATH QUADRANGLE.	
....	Topsham, on east abutment of railroad bridge over Topsham street, west of track; marked "41.5"..........	44.139
....	Brunswick, in left side of front entrance to building used as post-office and town hall; aluminum tablet..........	69.589

FROM BRUNSWICK, NORTH ALONG MAINE CENTRAL RAILROAD AND HIGHWAY, UP ANDROSCOGGIN RIVER.

	FREEPORT QUADRANGLE.	
3.1	Pejepscot, 58.5 feet south of center of track, 60 feet north of north end of railroad station, in pasture belonging to Emory Barnes, in ledge; aluminum tablet	175.421
9.9	Lisbon Falls, about 10½ miles from Lewiston, at side of river opposite lower end of Frosts Park, in ledge; aluminum tablet	111.231
	LEWISTON QUADRANGLE.	
14.0	Lewiston, 6½ miles from, on south abutment of Moody Brook Bridge, east of track; point marked "U.S.184"	186.683
15.2	Lewiston, 5.3 miles from, on west abutment of Crowley's bridge, south of track; point marked "S"	190.098
20.6	Lewiston, on west end of dam No. 4 Union Water Power Company; point marked "S"	170.608
24.9	Dingley farm, 300 feet east of road, near north line, in large bowlder; aluminum tablet	265.527
26.7	Babbett & Googin dam, in high point of ledge below (ledge is in bed of river and is an island during high water); aluminum tablet	225.889
	LIVERMORE QUADRANGLE.	
38.2	Keenes Mills Cemetery, about 0.25 mile north of, 150 feet east of highway, on river road, in low flat ledge; aluminum tablet	283.111
45.6	Strickland, about 1.8 miles above station, 150 feet north of A. E. Hunton's house, about 200 feet east of road, in ledge; aluminum tablet	296.970
50.9	Farmington, 17.6 miles from east abutment of Shuey plate-girder bridge; aluminum tablet	300.038
51.9	Livermore Falls, in southwest corner of post-office building; aluminum tablet	349.355

FROM LIVERMORE FALLS, ALONG THE MAINE CENTRAL RAILROAD AND THE GRAND TRUNK RAILWAY AND HIGHWAYS, UP ANDROSCOGGIN RIVER, TO ERROL, N. H.

	LIVERMORE QUADRANGLE.	
00.00	Livermore Falls, in southwest corner of post-office building; aluminum tablet	349.355
1.2	Chisholm, 0.5 mile north of station, in downstream side of east abutment of Maine Central Railroad bridge over Androscoggin River; aluminum tablet (set horizontally)	355.716
2.7	Jay Bridge, 73 feet west of station, in vertical face of large bowlder; aluminum tablet	382.965
4.9	Rileys, 176 feet north of station, in granite rock ledge; aluminum tablet	396.175
	BUCKFIELD QUADRANGLE.	
8.2	Meadowview, near the west end of the first "out" west of, in first granite ledge west of Meadowview station, south of railway; aluminum tablet	391.726
10.4	Gilbertville, on right upstream bridge seat of steel highway bridge over Androscoggin River; aluminum tablet	395.591
14.9	East Peru, 0.3 mile east of, on northwest bridge seat of railroad bridge over Worthley Brook; aluminum tablet	394.961
	DIXFIELD QUADRANGLE.	
20.4	Androscoggin River, bridge over, between West Peru and Dixfield, cemented in southwest bridge seat of highway; aluminum tablet	411.482
	RUMFORD QUADRANGLE.	
25.2	Rumford Falls, in northeast corner of Rumford Water Company building on Commerce street; aluminum tablet	507.787
26.1	Rumford Falls, on southwest corner of bridge seat of west abutment of highway bridge over the river just above the upper dam; aluminum tablet	625.447
32.9	Rumford Center, 0.25 mile from, about 120 feet west of Rumford Center-Rumford Point, easily seen about 5 feet higher than road, set approximately vertical on east side of bowlder at base of hill, opposite halfway between blazed telegraph poles; aluminum tablet	629.508
35.4	Rumford Point, in southeast corner of foundation of A. J. Marbles's house; aluminum tablet	635.876
	BETHEL QUADRANGLE.	
42.5	Newry Corner (on road to Bethel), 500 feet south of, in east corner of north abutment of high bridge over Bear River; aluminum tablet	635.916
48.2	Androscoggin River, highway bridge over, between Mayville and Bethel, in west end of south abutment of; aluminum tablet [a]	647.566
53.2	West Bethel, 1 mile west of, in northeast corner of east abutment of highway bridge over Pleasant River; aluminum tablet	655.764
58.7	Gilead, 0.5 mile west of, in north corner (second course from top) of east abutment of Grand Trunk Railway bridge over Wild River; aluminum tablet	712.052

---

[a] The elevation of this bench mark by topographic branch from Portland is 649.885.

Several unnamed quadrangles.

PENOBSCOT, PISCATAQUIS, AND SOMERSET COUNTIES.

The elevations in the following list of bench marks established by the water-resources branch of the United States Geological Survey, under the general direction of H. K. Barrows, district engineer, were determined from double-rodded primary-level lines run with a 20-inch Gurley wye level and two Philadelphia rods. These elevations result from a preliminary adjustment, under which the elevations at Medway and Moosehead, determined by the primary-level lines of the topographic branch extended from Bangor and Portland were accepted without correction. A new adjustment will not be made unless shown to be advisable when additional primary connections have been made between Penobscot and Kennebec rivers.

In running the base levels of 1905 from Chesuncook to Northeast Carry and from Moosehead west to Jackman, George M. Brett was chief of party. In running the base levels of 1906 on West Branch Penobscot River, from Chesuncook Lake southeast to Norcross, and the base levels of 1907 from Allagash Lake to Grand Lake dam H. S. Boardman was chief of party. In running the base levels of 1908 from Grand Lake dam southeast down East Branch Penobscot River to Medway H. S. Boardman was chief of party and A. L. Grover was instrument man.

Primary leveling by the water-resources branch in several unnamed quadrangles.

FROM CHESUNCOOK TO NORTHEAST CARRY.

Distance in miles.	Location and description of bench mark.	Elevation in feet.
....	Chesuncook, 18 feet east of post-office, in top of 6-foot post; iron bolt	934.931
....	Chesuncook, 150 feet south of post-office, in root of stump; nail	931.757
....	Chesuncook Hotel, 1,000 feet west of, in telephone pole at top of hill; spike	1,009.133
1.6	Chesuncook, 1.6 miles from, in pine tree on right side of trail; nail	1,015.318
2.5	Chesuncook, 2.5 miles from; small bowlder on left side of trail	930.449
2.94	Chesuncook, 2.94 miles from, 1,000 feet below mouth of Pinetree Stream, 10 feet above water, on right bank of Penobscot River, in ledge; aluminum tablet (permanent bench mark No. 1)	936.907
3.39	Chesuncook, 3.39 miles from, in stump on right side of trail; nail	946.668
3.39	Chesuncook, 3.39 miles from; top of bowlder right side of trail	949.060
4.17	In telephone pole; spike	1,005.350
5.72	Foxhole Rips, at foot of, in ledge on right bank of river; aluminum tablet (permanent bench mark No. 2)	945.027
6.6	Jim Smith's halfway house, 3.1 miles below, in pine tree at southwest end of field; nail	951.444
7.3	In root of pine tree at right of trail; nail	979.059
7.95	In root of cedar tree at left of trail; nail	961.358
8.14	On bowlder at edge of water	954.868
8.7	In root of cedar tree at right of trail; spike	968.291
9.7	Jim Smith's halfway house, 150 feet west of, in vertical face of bowlder on right bank, 1 foot from ground; aluminum tablet (permanent bench mark No. 3)	964.571
10.35	In fir tree at right of trail, 3 feet from ground; nail	985.635
10.5	In root of fir tree at right of trail; nail	995.457
11.7	Moosehorn Stream, 225 feet above, in poplar tree at right of trail, 1.5 feet from ground; iron pin	969.497
11.9	In poplar tree at right of trail, 1 foot from ground; spike	971.747
13.3	In root of large poplar tree at right of trail; nail	969.117
13.9	In root of birch tree at left of trail; nail	969.784
14.4	In birch stump at left of trail; nail	971.249
15.6	In root of spruce tree at left of trail; spike	970.814
16.2	In root of cedar tree at right of trail; spike	973.243
16.99	In root of fir tree at left of trail; spike	973.020

Primary leveling by the water-resources branch in several unnamed quadrangles—Cont'd.

FROM CHESUNCOOK TO NORTHEAST CARRY—continued.

Distance in miles.	Location and description of bench mark.	Elevation in feet.
17.59	In root of fir tree at right of trail; spike	970.971
17.9	Lobster Stream, east end of bridge over, nearly flush with ground; long iron bolt driven into top of stump	979.269
18.4	In telephone pole at right of trail; spike	972.198
19.5	In root of fir tree at left of trail; spike	972.307
20.5	Landing place at river, 500 feet south from, at left of road to Northeast Carry; top of bowlder	980.336
21.8	Northeast Carry, 0.5 mile north of, in root of poplar tree west of road; nail	1,077.924
22.5	Northeast Carry, 200 feet southwest of Winnegarnock House, about 100 feet from shore of Moosehead Lake, on top of bowlder; aluminum tablet (permanent bench mark No. 4)	1,033.429
	Bench mark of Kennebec Water Power Company, marked "22.36;" copper bolt cemented in same bowlder	1,033.594

FROM MOOSEHEAD WEST TO JACKMAN.

....	Moosehead, abutment of Canadian Pacific Railway bridge, southeast corner, on east side of Moosehead Lake; aluminum tablet stamped "1026 AUGUSTA" (permanent bench mark No. 1)	1,028.154
0.86	In third telegraph pole southeast of signpost "Moosehead 1 mile" at left of track, 1 foot from ground; railroad spike	1,064.979
2.8	In third telegraph pole west of milepost 47, 1 foot from ground; railroad spike	1,018.451
3.9	Milepost 48, 800 feet west of, south of track; small bowlder	1,027.079
4.4	Moosehead, 4.4 miles west of, on top of top stone of northeast wing wall of bridge over west outlet of Moosehead Lake; aluminum tablet (permanent bench mark No. 2)	1,028.215
5.95	Rock at south side of track	1,105.040
7.74	Askwith, 1,000 feet west of, on top of top stone of southeast wing wall of bridge over Misery Stream; aluminum tablet (permanent bench mark No. 3)	1,109.807
9.73	Milepost 54, 350 feet east of, south of track; bowlder	1,081.662
11.06	Milepost 55, about 1,200 feet west of, north of track; bowlder	1,112.959
12.71	In fourth telegraph pole east of milepost 57, south of track, 2 feet from ground; spike	1,138.652
....	Milepost 58; spike (temporary bench mark of Canadian Pacific Railway)	1,171.516
14.6	Mackamp, 1.5 miles east of, 25 feet east of end of dam, 15 feet south of storehouse, in bowlder near south end of Long Pond dam on Moose River; aluminum tablet (permanent bench mark No. 4)	1,159.911
14.7	Milepost 59; spike (temporary bench mark of Canadian Pacific Railway)	1,173.091
15.53	Mackamp, 0.5 mile east of, 1,300 feet east of milepost 60; bowlder south of railroad track	1,168.883
17.2	Mackamp, 1 mile west of, opposite sign "Mackamp 1 mile;" bowlder north of track	1,179.401
18.88	Opposite milepost 63; bowlder north of track	1,185.980
19.2	Mackamp, 3 miles west of, on top stone of northeast abutment of bridge over Parlin Stream; aluminum tablet (permanent bench mark No. 5)	1,168.973
....	Milepost 64; spike (temporary bench mark of Canadian Pacific Railway)	1,163.311
22.22	Long Pond station, 800 feet west of; bowlder 25 feet south of track	1,177.959
24.3	Long Pond, 75 feet from shore of, where railroad leaves the pond; northeast corner of stone culvert under railroad track	1,177.475
26.55	Milepost 71, 0.25 mile east of, in telegraph pole south of track; spike	1,165.693
29.56	Jackman, opposite railroad station; bowlder south of track	1,222.212
30.2	Jackman, about 3,300 feet west of station; small bowlder south of track	1,199.445
31.51	Jackman, 2 miles west of, on northeast abutment of railroad bridge over Moose River between Wood and Attean ponds; aluminum tablet (permanent bench mark No. 6)	1,170.357
....	Brassua Lake, on east shore 20 feet from water, 2,000 feet from mouth of Misery Stream, 4,900 feet from Moose River outlet, on top of, bowlder; aluminum tablet.	1,050.72

FROM CHESUNCOOK LAKE, SOUTHEAST ON WEST BRANCH PENOBSCOT RIVER, TO NORCROSS.

....	Chesuncook Lake, at foot of, 100 feet south and 30 feet east of end of dam; Great Northern Paper Company's bench mark No. 15 (elevation given, 945.647)	943.019
....	Chesuncook dam, near south end of; on large rock marked "G S"	936.102 935.440
....	Chesuncook dam, in top of high ledge just south of south wing; aluminum tablet (permanent bench mark No. 1)	956.741
0.70	Ripogenus Lake, head of, lower end of long carry, on two medium-sized bowlders; marked "G S"	897.752 897.311
2.94	Ripogenus Lake, foot of, near shore in front of hovel; on rock; marked "U S G S"	892.936 892.594
3.65	Ripogenus Lake, below, on rock by ledge along carry road, marked "G S"	978.213 978.450

Primary leveling by the water-resources branch in several unnamed quadrangles—Cont'd.

FROM CHESUNCOOK LAKE, SOUTHEAST ON WEST BRANCH PENOBSCOT RIVER, TO NORCROSS—continued.

Distance in miles.	Location and description of bench mark.	Elevation in feet.
4.03	On rock on top of highest steep pitch, near big yellow birch on carry road marked "Elevation 976.44" (Great Northern Paper Company's bench mark No. 13)	973.943
4.40	Carry road, 20 feet north of, on black rock about 2 feet wide by 2½ feet long by 2 feet high, on top of knoll of putting-in place, small fir 10 feet west marked "Elevation 799.64" (Great Northern Paper Company's bench mark No. 12)	797.137
5.11	"The Arches," in ledge, pine tree beside the carry road on which is placed telephone box bears N. 80° W. 57 feet, end of wing dam bears about N. 45° E. 175 feet; aluminum tablet (permanent bench mark No. 2)	724.831
5.37	Big Eddy, north of road, about 200 feet above clearing, maple tree 6 inches in diameter 5 feet east of rock marked "Elevation 688.96," large triangular rock; point of rock (Great Northern Paper Company's bench mark No. 11)	686.487
5.45	Big Eddy, at southwest corner of grass plot, about 13 feet from large pine tree marked "Elevation 683.76;" painted stone (Great Northern Paper Company's bench mark No. 10)	681.288
5.49	Big Eddy, on root of pine tree near camp; turning points marked "U S G S"	683.046 682.659
6.48	Little Ambajemackomus Falls, on rock 500 feet below foot of falls, on right shore, marked "U S G S"	659.496 659.725
7.28	Big Ambajemackomus Falls, rock on right shore at head of falls, marked "U S G S"	657.867 657.627
8.56	Horse race on good-sized white rock near where new telephone line crosses river; point of cross marked "B M elevation 623.74. U S G S" (Great Northern Paper Company's bench mark No. 9)	621.190
8.95	Horse race, foot of, on right shore, in top of bowlder on small knoll about 75 feet from river, about 220 feet from dead water, birch tree 12 inches in diameter bears west 12 feet, marked "U S G S B M No. 3;" aluminum tablet (permanent bench mark No. 3)	617.296
11.17	Sourdnahunk Deadwater, foot of, on left bank, 1,100 feet above dam, on rock marked "U S G S"	605.132 604.867
11.32	Sourdnahunk dam, in ledge on upper end of "heater" above overflow of dam (station "S" on cross-section work of August, 1903, elevation 617.36); wooden plug with nail in center (Great Northern Paper Company's bench mark No. 8)	614.801
14.02	Katahdin Stream, about 0.25 mile above dryway at island, 250 feet from and on opposite shore from dryway, on large bowlder marked "U S G S"	569.160 568.767
14.84	Abol Stream, opposite mouth of stream on right bank, on large bowlder marked "U S G S"	567.190 566.876
15.08	Abol carry road, right of river, beside road, near upper end of long carry road, 115 feet from bank, in top of large triangular bowlder, poplar tree bears N. 17½ feet, another poplar tree bears E. 9 feet, spotted and marked "U S B M No. 4;" aluminum tablet (permanent bench mark No. 4)	580.275
15.43	Abol Falls, on large round granite rock 30 feet northeast from north end of wing on carry side of the falls, elevation 571.945; mark (Great Northern Paper Company's bench mark No. 7)	569.408
16.59	Packwackamus Falls, on right bank, opposite middle of lower pitch, 60 feet from lower end of carry, on bowlder	534.432 534.056
17.64	Packwackamus Deadwater, head of, on right bank, about 200 feet below cottage of W. H. Gannett, on large bowlder	531.569 530.577
18.95	Packwackamus Deadwater, foot of, 0.72 mile above head of Debsconeag Falls on large rock in middle of main channel	533.721 533.326
19.94	Debsconeag Falls, rock on right bank below falls, above high water, on largest granite rock; mark (Great Northern Paper Company's bench mark No. 5)	513.910
19.94	Debsconeag Falls, on right bank, near lower end of carry road, at foot of falls in top of largest granite rock; aluminum tablet set horizontally (permanent bench mark No. 5)	513.858
20.82	Debsconeag Deadwater, head of, on two large bowlders, 5 feet apart, left shore, 75 feet north of landing at Joe Frances's ice house	503.705 502.783
22.53	Debsconeag Deadwater, foot of, on island 400 feet above Hopkins Pitch, on right bank of main channel, on two large bowlders 6 feet apart	502.287 502.060
23.19	Passamagormuc Falls, head of, at upper end of short carry, left shore, 180 feet above head of falls, on two large bowlders 6 feet apart	499.549 499.648
23.40	Passamagormuc Falls, foot of, on rock at putting-in place, Joe Cripp's camp, left bank in cove; cross on tree marked "T P elevation 488.733" (supposed to be Great Northern Paper Company's bench mark No. 3)	491.055
24.36	Dead water between Passamagormuc and Ambajejus Falls, on left bank, 300 feet above first island above Ambajejus Falls, on large rock	491.679 491.933
25.23	Ambajejus Falls, on right shore, at top of ridge, in rock; iron pin (Great Northern Paper Company's bench mark No. 2)	514.459
25.39	Ambajejus Falls, above road at side of bluff between foot of falls and McPhetres Camp, on right bank, at head of Lake Ambajejus, in top of granite bowlder; aluminum tablet set horizontally (permanent bench mark No. 6)	496.608
25.39	Ambajejus Falls, near water's edge opposite bench mark No. 6, on large bowlder	483.982 482.622
....	North Twin Lake; Great Northern Paper Company's bench mark, elevation 503.480	503.42
....	Norcross Cove; on bowlder near old boat landing; Great Northern Paper Company's bench mark, elevation 488.661	488.568
....	North Twin Lake (4.87 miles southwest of Millinocket), top of north pier at 24-foot gate opening; aluminum tablet stamped "495"	494.562

Primary leveling by the water-resources branch in several unnamed quadrangles—Cont'd.

FROM ALLAGASH LAKE TO GRAND LAKE DAM.

[Distances in miles from Chesuncook.]

5.00	Umbazooksus Stream, beside carry at head of dead water (elevation 937.04 marked on blazed tree); point on rock (bench mark of Great Northern Paper Company).	934.357
5.00	On same rock, marked "U S G S No. 7;" point "A"	934.332
5.91	Umbazooksus Stream, on right bank of, at water's edge; rock	939.131
5.91	On same rock, marked "U S G S No. 6;" point "A"	939.558
7.16	Umbazooksus Lake, 35 feet from shore of, at end of Mud Pond carry; granite rock.	946.372
7.16	On same rock, marked "U S G S No. 5;" point "A"	947.043
8.12	Mud Pond, about 0.8 mile from putting-in place, 5 feet west of Mud Pond carry; rock	994.187
8.12	On same rock, marked "U S G S No. 4;" point "A"	994.142
8.87	Mud Pond, at putting-in place at end of Mud Pond carry; rock	961.502
8.87	On same rock, marked "U S G S No. 3;" point "A"	961.470
9.87	Mud Pond, 10 feet below north end of dam at outlet; granite bowlder	958.649
9.87	On same rock, marked "U S G S No. 2;" point "A"	958.379
10.05	Mud Pond Brook, about 80 feet north of, 60 feet east of logging camp; rock	953.806
10.05	On same rock, marked "U S G S No. 1;" point "A"	953.620
10.45	Mud Pond Brook, 600 feet north of foot of quick water, 150 feet east of edge of woods, on top of outcropping ledge (at high water this ledge is entirely surrounded by several feet of water); aluminum tablet	946.234
23.56	Telos dam, about 250 feet from road, 735 feet from opening in woods, in bowlder about 3 by 5 feet; aluminum tablet	967.101
24.45	Webster Lake, about 75 feet from shore of, in carry between Telos and Webster lakes, in turn around; rock	899.463
24.45	On same rock, marked "U S G S No. 13;" point "A"	899.828
26.48	Webster Brook, 80 feet upstream from upper end of carry, in edge of lake (covered in time of high water); rock	895.876
26.48	On same rock, marked "U S G S No. 14;" point "A"	895.717
28.63	Webster Brook carry, 1.15 miles from upper end and 2 feet south of; rock	917.048
28.63	On same rock, marked "U S G S No. 15;" point "A"	917.069
29.48	Webster Brook carry, 2 miles from upper end and 2 feet south of; rock	831.431
29.48	On same rock, marked "U S G S No. 16;" point "A"	830.989
30.73	Webster Brook carry, 3.25 miles from upper end and south of, beside blazed and marked tree; rock	800.849
30.73	On same rock, marked "U S G S No. 17;" point "A"	801.101
33.36	Indian Pitch, on south bank of Webster Brook, 200 feet upstream from dam, about 10 feet higher than surrounding country and 20 feet from water in brook, in outcropping ledge; aluminum tablet	790.385
34.73	Webster Brook carry, 10 feet south of, 1.25 miles below dam at Indian Pitch, in root of pine tree; nail	781.584
34.73	On root of same tree, marked "U S G S No. 18;" point "A"	781.251
36.12	Second Lake, near head of, in west end of an outcropping ledge about 3 feet above the general surface of ground (ledge gradually rises toward the east, reaching a maximum height of about 35 feet); aluminum tablet	661.092
42.56	Grand Lake, shore of, near Harveys Landing, with chiseled letters and painted white circle around hemispherical head, set flush in ledge; iron bolt marked "U ⊙ S"	656.111
45.21	Grand Lake dam, 200 feet upstream from west end of, 10 feet from water's edge when gage at dam reads 13.5 feet, in outcropping ledge; aluminum tablet	662.078

CHAMBERLAIN LAKE NORTHWEST TO ALLAGASH LAKE.

9.60	Allagash Stream, 2 miles below Allagash Falls, in "tote" road near foot of quick water; rock 2½ feet broad and 1 foot high	945.763
9.60	On same rock, marked "U S G S No. 13;" point "A"	945.677
10.60	Allagash Stream, 1 mile below Allagash Falls, 2 feet south of "tote" road; rock	960.033
10.60	On same rock, marked "U S G S No. 11;" point "A"	959.472
11.60	Allagash Stream, at falls, on left bank of stream, 10 feet below wing dam; rock ledge	987.555
11.60	On ledge near above, marked "U S G S No. 10;" point "A"	987.490
12.95	Allagash Stream, left bank of, 2 miles below dam at Allagash Lake; large broken bowlder in water's edge	992.347
12.95	On same bowlder, marked "U S G S No. 9;" point "A"	992.269
14.25	Allagash Stream, left bank of, about 0.8 mile from dam at Allagash Lake; flat rock.	1,015.340
14.25	On same rock, marked "U S G S No. 8;" point "A"	1,014.968
14.95	Allagash Lake, 850 feet upstream from dam, about 175 feet from stream, in outcropping ledge 15 feet from "tote" road and behind a higher ledge which lies between tablet and stream; aluminum tablet	1,074.037

Primary leveling by the water-resources branch in several unnamed quadrangles—Cont'd.

FROM GRAND LAKE DAM, SOUTHEAST DOWN EAST BRANCH PENOBSCOT RIVER, TO MEDWAY.

5.82	Stair Falls, at head of lower pitch on right bank, on outcropping ledge 5 to 10 feet from edge of water; aluminum tablet	595.737
10.66	Bowlin Falls, 40 feet from edge of water, on right bank at head of falls, in ledge; aluminum tablet	446.662
14.05	United States fish hatchery, on left bank opposite mouth of Little Spring Brook, in outcropping ledge known as Sufferers Rock; aluminum tablet	401.615
24.60	Hunt Island, opposite head of, one-eighth mile above Matagamon House, in granite bowlder on east side of wagon road on left bank of river, about 25 feet from water's edge; aluminum tablet	352.554
27.40	Whetstone Falls, on left bank at foot of falls, about 25 feet from water's edge, about 150 feet above lower end of carry; rock ledge	339.955
33.06	Soldiers Brook, 300 feet above mouth, on right bank, in granite bowlder about 25 feet from mean low water edge; aluminum tablet	314.924
38.25	Grindstone, in north end of coping stone on east pier of Bangor and Aroostook Railroad bridge, left bank of river; aluminum tablet	317.153
45.59	Ledge Falls, in large flat-topped bowlder, 10 feet east of highway; tablet (not quite horizontal, elevation of highest point, not center)	285.904
48.11	Medway, 0.27 mile west of, 50 feet east of road, 120 feet west of house of A. T. Reed, in ledge; aluminum tablet stamped "279"	278.911

NEW HAMPSHIRE.

PRECISE LEVELING.

Benton, Campton, Ossipee, Rumney, Silver Lake, Squam Lake, Winnepesaukee, and Woodsville quadrangles.

BELKNAP, CARROLL, AND GRAFTON COUNTIES.

The elevations in the following list are the New Hampshire portion of the results of the line of precise levels run in 1906 by N. A. Campbell from Portland, Me., northwest along the Maine Central Railroad and highways to the Maine–New Hampshire state line; thence across the State of New Hampshire, via Lake Winnepesaukee and South Newbury, Vt., to White River Junction, Vt., where a check was obtained on a bench mark whose elevation was determined by checked primary levels from a tidal bench mark near Portsmouth, N. H. At White River Junction the elevation of the tablet in the wall of the Catholic Church by precise line from Portland, Me., was 367.777 feet, and by double-primary line from Portsmouth, N. H., 367.022 feet, the weighted mean value adopted being 367.527 feet. The error, 0.250 foot, was distributed over the New Hampshire–Vermont portion.

SILVER LAKE QUADRANGLE.

MAINE-NEW HAMPSHIRE STATE LINE NEAR FREEDOM, NORTHWEST ALONG HIGHWAY TO FREEDOM; THENCE SOUTHWEST TO CENTERVILLE.

	Feet.
East Freedom, in an angle of road forks, in rock; aluminum tablet stamped "406"	405.954
Freedom, 640 feet from post-office, 50 feet west of road, in rock; aluminum tablet stamped "452"	451.624
Effingham Falls, 2.2 miles west of, south side of road, in rock; aluminum tablet stamped "433"	433.057
Centerville, first road northeast of and 300 feet from station; 10 feet from road; aluminum tablet stamped "529"	528.710

OSSIPEE QUADRANGLE.

CENTERVILLE, SOUTH ALONG HIGHWAY TO OSSIPEE; THENCE SOUTHWEST TO WOLFBORO.

	Feet.
Centerville, 3.9 miles southeast of, northeast side of track, 100 feet south of third-class road; aluminum tablet stamped "598"	597.451
Ossipee, 2.4 miles west of, in southwest corner of field, in rock; aluminum tablet stamped "852"	852.275
Ossipee, 5.4 miles southwest of, about 6 feet northwest of road; aluminum tablet stamped "660"	660.116
Lake Winnepesaukee, August 4, 1906; surface of water (falling 0.03 foot per day)	504.071

WINNEPESAUKEE QUADRANGLE.

AT MEREDITH.

Meredith; 6-foot mark on gage at wharf	507.031
Meredith, at forks of Wanhaman and Main streets; aluminum tablet stamped "549"	548.884

SQUAM LAKE QUADRANGLE.

MEREDITH, NORTHWEST ALONG BOSTON AND MAINE RAILROAD, TO PLYMOUTH.

Meredith, in front of station; top of rail	547.9
Waukawan Lake; surface of water	539.0
Meredith, 3 miles northwest of, 25 feet west of track; aluminum tablet stamped "562"	561.710
Ashland, 0.7 mile southeast of, 20 feet northeast of track, in rock; aluminum tablet stamped "597"	596.811
Ashland, in front of station; top of rail	556.6
Bridgewater, in front of station; top of rail	490.0
Bridgewater, 0.4 mile northwest of, west of track, in rock; aluminum tablet stamped "486"	485.749
Plymouth, in front of station; top of rail	483.8
Plymouth, at station, north entrance to baggage room, in stone step; aluminum tablet stamped "485"	485.127

CAMPTON QUADRANGLE.

PLYMOUTH, NORTHWEST 2.6 MILES ALONG BOSTON AND MAINE RAILROAD.

Plymouth, 0.3 mile northwest of, north of track; switch-stand bolt	493.27

RUMNEY QUADRANGLE.

NEAR PLYMOUTH, ALONG BOSTON AND MAINE RAILROAD, WEST TO WEST RUMNEY AND NORTH TO WARREN SUMMIT.

Plymouth, 3.7 miles northwest of, on northeast side of track, in top of culvert; aluminum tablet stamped "480"	479.718
Quincy, in front of station; top of rail	514.7
Quincy, 1.4 miles northwest of, on southwest abutment of overhead highway bridge; aluminum tablet stamped "511"	510.430
Rumney, in front of station; top of rail	526.9
Rumney, 1 mile northwest of, on south abutment of arch railroad culvert; aluminum tablet stamped "527"	526.718
West Rumney, in front of station; top of rail	526.7
West Rumney, 1.2 miles northwest of, 140 feet east of track, in ledge; aluminum tablet stamped "540"	539.353

	Feet.
West Rumney, 4.9 miles northwest of, 25 feet east of track, 100 feet northwest of bridge, in field, in ledge; aluminum tablet stamped "574"	572.850
Wentworth, in front of station; top of rail	597.8
Wentworth, 2.1 miles northwest of, 15 feet east of track, in rock; aluminum tablet stamped "688"	686.860
Wentworth, 2.9 miles northwest of, road crossing; top of rail	707.2
Warren, 1.5 miles northwest of, in rock, west of track; aluminum tablet stamped "847"	846.750
Warren, 4.4 miles northwest of, in rock cut, west of track, in ledge; aluminum tablet stamped "1068"	1,067.368
Glencliff (Warren Summit post-office), in front of station; top of rail	1,043.5

BENTON QUADRANGLE.

POINT 3.4 MILES NORTHWEST OF GLENCLIFF, ALONG BOSTON AND MAINE RAILROAD TO POINT 1.4 MILES NORTHWEST OF EAST HAVERHILL.

Glencliff, 3.4 miles northwest of, northeast of track, in bowlder; aluminum tablet stamped "832"	831.450
East Haverhill, in front of Boston and Maine Railroad station; top of rail	785.4
East Haverhill, 1.4 miles northwest of, culvert 87; aluminum tablet stamped "751"	750.470

WOODSVILLE QUADRANGLE.

POINT 1.4 MILES NORTHWEST OF EAST HAVERHILL, ALONG BOSTON AND MAINE RAILROAD, TO HAVERHILL.

Pike, in front of Boston and Maine Railroad station; top of rail	749.7
Haverhill, at second road crossing west of station, west of track; aluminum tablet stamped "565"	564.390

PRIMARY LEVELING.

Boscawen, Squam Lake, and Winnepesaukee quadrangles.

BELKNAP, CARROLL, AND GRAFTON COUNTIES.

The elevations in the following list depend on water surface of Lake Winnepesaukee as determined by the precise-level line run with a prism level by N. A. Campbell and party from Portland, Me., in 1906. During August, 1906, gages were established at Wolfboro and Meredith, and observations were taken until September, thereby obtaining a close approximation of the daily water level.

WINNEPESAUKEE QUADRANGLE.

NEAR LAKE WINNEPESAUKEE.

	Feet.
Melvin, 100 feet north of main road, east of first road to north going west from post-office, in rock; aluminum tablet stamped "522"	520.204
Moultonboro, at road fork northeast of post-office, in rock beside road; aluminum tablet stamped "597"	597.176
Center Harbor, northwest of lake, in lot back of Moulton, 260 feet from street, in rock; aluminum tablet stamped "567"	567.393
Lakeview, 1.5 miles east of stone entrance to Kona farm, north of road, 15 feet from stone wall, in rock in field; aluminum tablet stamped "558"	557.647
The Weirs, at northwest end of harbor, in front of northwest end of Weirs Hotel, 100 feet from water's edge and 100 feet north of track, in rock; aluminum tablet stamped "520"	520.370

	Feet.
Lakeport, about 1,200 feet northeast of station, 50 feet west of Lakeshore Railroad, in rock; aluminum tablet stamped "507"	506.428
Sanders, 0.4 mile west of station, in bowlder north of road; aluminum tablet stamped "508"	508.072
West Alton, 300 feet northwest of station, about 50 feet west of track, in rock in apple orchard; aluminum tablet stamped "570"	569.953
Mount Major, 240 feet southeast of station, 20 feet west of track, in rock; aluminum tablet stamped "518"	517.919
Gilford village, 90 feet south of highway to Lakeport, 108 feet west of highway to Laconia, 5 feet from creek, in rock; aluminum tablet stamped "730"	729.717

LAKEPORT, ALONG HIGHWAY, TO LACONIA.

Lakeport, in front of station; top of rail	509.8
Laconia, Masonic Temple, on right side of main entrance between pillar and wall of entry; aluminum tablet stamped "503"	502.768
Laconia, in front of station; top of rail	504.3

BOSCAWEN QUADRANGLE.

LACONIA TO SANBORNTON.

Laconia, 2.8 miles southwest of, southeast of track, in rock; aluminum tablet stamped "499"	499.578
Winnisquam, in front of station; top of rail	490.9
East Tilton village, at road forks, in front yard of school-house, in rock; aluminum tablet stamped "545"	544.444
Sanbornton, 150 feet north of post-office, 8 feet west of road, 10 feet from dwelling house, in rock; aluminum tablet stamped "824"	822.283

SQUAM LAKE QUADRANGLE.

AT MEREDITH CENTER.

Great Bay, September 10, 1906; surface of water	481.302
Meredith Center, in front of church, in rock; aluminum tablet stamped "525"	525.106

AT GAZA.

Gaza, 75 feet southwest of post-office, south of east-west road, in rock; aluminum tablet stamped "708"	706.702

HILL, ALONG BOSTON AND MAINE RAILROAD, TO BRISTOL; THENCE ALONG HIGHWAY, TO BRIDGEWATER STATION.

Hill, in front of station; top of rail	326.5
Hill, at Hill Center-Danbury road forks, west of road to Hill, north of road to Hill Center, in rock; aluminum tablet stamped "348"	347.011
Hill, 2.8 miles northwest of, northeast of track, in bowlder 12 feet above level of track; aluminum tablet stamped "344"	342.708
Bristol, in front of station; top of rail	359.7
Bristol, in public square, soldiers' monument, in pedestal; aluminum tablet stamped "467"	465.498
New Hampton, in north step of Gordon-Nash Library, in right end of step; aluminum tablet stamped "532" (single spur)	530.96
New Hampton, 3.7 miles north of, opposite dwelling house, in rock, in field; aluminum tablet stamped "477"	476.778
North Sanbornton, in field at northwest corner of road, 80 feet from post-office, in rock; aluminum tablet stamped "633"	631.695

ASHLAND, TO SQUAM LAKE (DOUBLE SPUR LINE).

	Feet.
Holderness, at first road fork east of post-office, in rock; aluminum tablet stamped "581"	581.405
Squam Lake, September 25, 1906; surface of water	559.97

Claremont, Concord, Dover, Hanover, Haverhill, Manchester, Mascony Lake, Milford, Mount Kearsarge, Nottingham, Peterboro, Sunapee, Suncook, and York quadrangles.

CHESHIRE, GRAFTON, HILLSBORO, MERRIMAC, ROCKINGHAM, AND SULLIVAN COUNTIES.

The elevations in the following list are based on the gage bench mark at Portsmouth Harbor of the United States Engineer Corps, and of the Coast and Geodetic Survey, consisting of a copper bolt in solid rock 6 feet from wall of old Fort Constitution, opposite cross cut in wall, 3 feet above ground, 127 feet from a wall at right angles to main wall of old fort, 47.9 feet from gate in main wall. The elevation of this bench mark is accepted as 10.17 feet, as determined by the Coast and Geodetic Survey from 143 readings, each of high and low water, taken between September 11 and November 24, 1898. From this point a double-rodded primary-level line was run over the Boston and Maine Railroad, via Manchester, Concord, and Claremont Junction, to White River Junction, Vt., where it connects with the precise-level line from Portland, Me. Of the total closure error of 0.755 foot, 0.5 foot has been corrected by adjustment between Portsmouth and White River Junction. For additional elevations on Hanover and Claremont quadrangles see Vermont list (p. 46).

The leveling was done as follows: In Peterboro quadrangle, by W. R. Harper in 1897; in Dover, Manchester, Nottingham, Suncook, and York quadrangles by F. M. Goodhue in 1903; in Concord, Milford, Mount Kearsarge, Sunapee, and Suncook quadrangles by A. T. Paine in 1904; and in Claremont, Hanover, and Mascony Lake quadrangles by W. A. Anderson in 1905.

YORK QUADRANGLE.

FORT CONSTITUTION (NEWCASTLE), TO PORTSMOUTH (DOUBLE-RODDED LINE).

	Feet.
Fort Constitution, Newcastle, 6 feet from wall of old fort, opposite cross, 3 feet above ground, cut on wall, 127 feet from a wall at right angles to main wall of old fort, 47.9 feet from gate in main wall, in solid rock; copper bolt 1.75 inches in diameter (Coast and Geodetic Survey and United States Engineer Corps bench mark)	10.170

DOVER QUADRANGLE.

PORTSMOUTH, WEST ALONG BOSTON AND MAINE RAILROAD, TO HEDDING (DOUBLE-RODDED LINE).

Portsmouth, on street floor of Federal Building, west face of second window from northwest corner, in granite window seat; aluminum tablet stamped "30 CONCORD"	30.031

	Feet.
Rockingham Junction (town of South Newmarket), 0.1 mile east of, 33 feet east of timber pier of overhead highway bridge, 6 feet south of south rail, 5 feet above ground, in shelf of south face of railroad cut through ledge; aluminum tablet stamped "49 CONCORD"	49.058

NOTTINGHAM QUADRANGLE.

HEDDING, WEST ALONG BOSTON AND MAINE RAILROAD TO CANDIA (DOUBLE-RODDED LINE).

Epping, in west face of clock tower, 1 foot from southwest corner of town hall, 18 inches from ground, flush with brickwork; aluminum tablet stamped "129 CONCORD"	128.688
Raymond, in foundation of Methodist Church, east face, 1 foot from ground, 2 feet from northeast corner; aluminum tablet stamped "205 CONCORD"	205.048

SUNCOOK QUADRANGLE.

CANDIA, SOUTHWEST ALONG BOSTON AND MAINE RAILROAD, TO MANCHESTER (DOUBLE-RODDED LINE).

Candia, in south face of granite foundation of town hall, 9 inches from southwest corner, 18 inches above ground; bronze tablet stamped "498 CONCORD"	498.094
Massabesic, 0.2 mile east of station (town of Auburn), on northwest shore of Great Massabesic Lake, in top of large bowlder, 240 feet from track, 5 feet above water; bronze tablet stamped "255 CONCORD"	255.450

MANCHESTER, NORTH TO GARVINS FALLS (DOUBLE-RODDED LINE).

Amoskeag, east side of station, 3.5 feet from ground, in foundation of archway which forms a shed for driveway for carriages, in large rectangular sandstone; aluminum tablet stamped "200 CONCORD"	199.695
Martins, 0.14 mile due east of station, 200 feet west of four corners east of Martins station, 23 feet west of Mr. Kellogg's farm house, 10 feet south of road, in bowlder; aluminum tablet stamped	200.514
Hooksett, just south of station, in north abutment of red iron railroad bridge over Merrimack River, in northeast corner of north abutment, 5 feet west of bed plate; aluminum tablet stamped "194 CONCORD"	194.452
Robinsons, 0.5 mile north of flag station, in milestone "Concord, 5 miles north; Boston, 69 miles south;" aluminum tablet	210.523

CONCORD QUADRANGLE.

GARVINS FALLS, NORTHWEST ALONG BOSTON AND MAINE RAILROAD, TO CONTOOCOOK (DOUBLE-RODDED LINE).

Bow Junction, 150 feet southeast of station, in large bowlder; aluminum tablet stamped "236 CONCORD"	236.354
Concord, at front steps of state capitol, facing east, in large granite stone; aluminum tablet stamped "288 CONCORD"	287.885
West Concord, 150 feet south of railroad station, at southeast corner of curbing which surrounds the house of Mr. Gray, in large stone; aluminum tablet stamped	348.687
Mastyard, 1,000 feet west of flag station, in east abutment of wooden railroad bridge over Contoocook River; aluminum tablet stamped	365.736
Contoocook, opposite post-office, in northwest corner of public fountain; aluminum tablet stamped "367 CONCORD"	367.574

MANCHESTER, WEST ALONG BOSTON AND MAINE RAILROAD, TO PARKER.

	Feet.
Grasmere Junction, 300 feet east of station, 10 feet from track, in ledge; aluminum tablet stamped "257 CONCORD"	256.906
Goffstown, 500 feet from station, in front doorstep of Congregational Church; aluminum tablet stamped "306 CONCORD"	306.007
Parker, 500 feet from station, opposite Parker's residence, in west end of wall 2 feet from ground, in large stone; aluminum tablet stamped "318 CONCORD"	318.420

MANCHESTER QUADRANGLE.

MANCHESTER, SOUTHEAST TO DERRY; THENCE NORTHEAST TO CHESTER; THENCE WEST TO AUBURN.

Manchester, at post-office (federal building), in water table of east buttress of west flight of steps from Hanover street; aluminum tablet stamped "225 CONCORD"	224.839
Manchester, city hall, in steps of main (Elm street) entrance, in north end of second step from street; brass plug 1.5 inches in diameter	209.588
Manchester, corner West Auburn street and Depot Square, in top of fire hydrant; plug (city engineer's bench mark)	178.200
Goffs Falls, bridge over large brook through village, in east end, south abutment, 9 inches outside of rail of bridge, in granite top course; chisel mark	148.834
Derry, in west abutment of steps of Pinkerton Academy; bronze tablet stamped "344 CONCORD" (on short single spur line)	344.430
Chester, in brick basement of Baptist Church, 15 inches from northeast corner and 18 inches above ground; bronze tablet stamped "460 CONCORD"	459.736
Chester, 2.9 miles northwest of, near Chester-Auburn township line (town of Chester), west of road, 400 feet north of intersection with road to east, in outcrop of ledge; bronze tablet stamped "361 CONCORD"	361.367

WEST DERRY, ALONG RAILROAD SOUTHEAST TO WINDHAM DEPOT; THENCE SOUTHWEST TO NASHUA; THENCE NORTH TO GOFFS FALLS.

West Derry, in granite foundation of hook-and-ladder house, north face, 1 foot from northeast corner, 9 inches from ground; aluminum tablet stamped "280 CONCORD"	280.393
Windham Depot (town of Windham), east side of Worcester, Nashua and Portland track, 400 feet southwest of west crossing of Manchester and Lawrence track (both roads operated by Boston and Maine Railroad), 10 feet from and 4 feet above east rail, in projecting ledge; aluminum tablet stamped "327 CONCORD"	326.922
Nashua, in park, corner of Amherst and Concord streets, soldiers' memorial monument, in water table, south face, base (first plinth) of monument; aluminum tablet stamped "168 CONCORD"	168.747
Merrimack, north of, 0.3 mile north of Reeds Ferry station, east of tracks, at milepost 48, in top of large bowlder; bronze tablet stamped "133 CONCORD"	132.629

WINDHAM DEPOT, SOUTH TO CANOBIE LAKE (SINGLE SPUR LINE).

Windham Depot, 4 miles south of (town of Windham), between north ends of Canobie Lake and Cobbett pond, 45 feet from road, in yard at School No. 1, 45 feet from southeast corner of schoolhouse, in ledge; bronze tablet stamped "270 CONCORD"	269.763

MILFORD QUADRANGLE.

NASHUA, ALONG BOSTON AND MAINE RAILROAD, TO WILTON.

	Feet.
South Merrimack, 250 feet from Milford-Amherst road forks, midway between Dean and Miller cottages, 16 feet north of center of road, in ledge-bronze tablet stamped "214 CONCORD"	214.306
Milford, in front of station; top of rail	250.3
Milford, Unitarian Church, north side, in front base of buttress at portal, 1 foot above ground; bronze tablet stamped "271 CONCORD"	270.831
Richardson, crossing at station; top of rail	261.3
Wilton, 1.5 miles east of, 70 feet north of Jones crossing, on top of south abutment of highway bridge over Souhegan River; aluminum tablet stamped "285 CONCORD"	284.950

MILFORD, ALONG AMHERST-NEW BOSTON ROAD, TO PARKER.

Amherst, in foundation of public library, northwest corner, front side of building; aluminum tablet stamped "269 CONCORD"	268.068
Amherst, 2.9 miles north of, 0.4 mile south of blind road leading from Amherst-New Boston road to Mount Vernon, in bowlder; aluminum tablet stamped "489 CONCORD"	489.954
Amherst, 6 miles from, on Amherst-New Boston road, 0.2 mile south of four corners, 0.8 mile north of road to Mount Vernon, in bowlder; aluminum tablet stamped "684 CONCORD"	684.216
New Boston, opposite post-office, in northeast corner of front foundation of Presbyterian Church; aluminum tablet stamped "418 CONCORD"	418.294

AMHERST, ALONG BOSTON AND MAINE RAILROAD VIA BEDFORD, TO GRASMERE JUNCTION.

Baboosic, 50 feet northwest of station, in ledge; aluminum tablet stamped "242 CONCORD"	241.785
Bedford, in northeast corner of foundation on front side of Presbyterian Church; aluminum tablet stamped "325 CONCORD"	324.931

MILFORD, SOUTH ALONG BOSTON AND MAINE RAILROAD TO NORTH BROOKLINE (SPUR LINE).

North Brookline, 289 yards south of road forks, in ledge of rock; aluminum tablet stamped "302 CONCORD"	301.934

PETERBORO QUADRANGLE.

PETERBORO, ALONG BOSTON AND MAINE RAILROAD, TO ELMWOOD.

Nahors, 243 feet south of crossing, east of railroad and public road, in granite bowlder; copper bolt stamped "691"	689.881
Elmwood, at intersection of the Nashua and Keene and the Peterboro and Hillsboro branches of Boston and Maine Railroad; top of rail	688.1
Elmwood, 60 feet west of station, in side of triangle formed by tracks, in granite bowlder; copper bolt stamped "692 P"	690.784

ELMWOOD, ALONG BOSTON AND MAINE RAILROAD, TO EAST WILTON.

South Bennington, in front of station; top of rail	709.7
Greenfield, in front of station; top of rail	825.6
Russell, road crossing at station; top of rail	846.5
Russell, 1,200 feet south of station, 120 feet north of crossing near schoolhouse, in granite capstone at west side of culvert over brook; copper bolt stamped "838 P"	836.693

EAST WILTON, VIA WILTON CENTER AND PACK MONADNOCK, TO PETERBORO.

	Feet.
Wilton Center, 0.3 mile south of, near Livermore's sawmill, 60 feet west of road to Wilton Center, 90 feet west of bridge over stream past sawmill, in ledge east of road; copper bolt stamped "540 P"	538.088

PETERBORO, ALONG FITCHBURG RAILROAD, TO POINT 1 MILE NORTH OF CHESHIRE MILLS; THENCE TO WILDER.

Peterboro, in front of Fitchburg Railroad station; top of rail	722.5
Peterboro, in north face of square-dressed granite block in foundation supporting porch of entrance to town hall; bronze tablet stamped "744 P"	742.990
Noone, road crossing north of station; top of rail	765.9
Drury, in front of station; top of east rail	810.1
Hadley, at road crossing north of station; top of rail	895.0
Wilder, 110 feet west of Simon Rolfe's house, 180 feet north of Boston-Keene road, at intersection of Sharon and Peterboro roads, in granite bowlder in field; copper bolt stamped "1185 P"	1,185.730

WILDER, VIA HIGH BRIDGE, TO EAST WILTON.

New Ipswich, post-office and store, northeast corner of lower step at east entrance	977.37
High Bridge, 150 feet south of mill, on Boston-Keene road, stone bridge over Souhegan River; roadway	920.5
Greenville, town hall, in west face of granite foundation stone, 1 foot north of southwest corner of building, 2.5 feet above pavement; bronze tablet stamped "831 P"	829.148

MOUNT KEARSARGE QUADRANGLE.

CONTOOCOOK, WEST ALONG BOSTON AND MAINE RAILROAD, TO BRADFORD (DOUBLE-RODDED LINE).

Dimond, 600 feet north of flag station, 50 feet west of main road, in large bowlder; aluminum tablet stamped "421 CONCORD"	421.399
Warner, road crossing near station; top of rail	411.0
Warner, on southwest side of Pillsbury Free Library building, at top of stairs, in large rectangular stone; aluminum tablet	445.437
Roby, 280 feet east of flag station, 50 feet south of track, in large bowlder; aluminum tablet stamped "518 CONCORD"	518.733
Bradford, 400 feet west of station, north of track, in large bowlder; aluminum tablet stamped "684 CONCORD"	684.268

SUNAPEE QUADRANGLE.

BRADFORD, NORTHWEST ALONG BOSTON AND MAINE RAILROAD, TO KELLYVILLE (DOUBLE-RODDED LINE).

Morse's crossing, 600 feet northwest of, 2 miles southeast of Newbury station, in large bowlder; aluminum tablet stamped	952.651
Sunapee Lake, at Newbury, on October 14, 1904; surface of water	1,090.02
Mount Sunapee, 75 feet east of station, in large flat bowlder; aluminum tablet stamped "1125 CONCORD"	1,125.374
Spectacle Pond at Mount Sunapee, October 15, 1904; surface of water	1,113.74
Sunapee, 800 feet northwest of station, at foundation of stone culvert over brook, in large granite stone; aluminum tablet stamped "927 CONCORD"	927.806
Newport, at south corner of front steps of town hall; aluminum tablet stamped	816.040
Kelleyville, 500 feet northeast of flag station, 75 feet north of track, in small bowlder; aluminum tablet stamped "687 CONCORD"	686.937

NEWPORT, SOUTH ALONG HIGHWAYS TO UNITY; THENCE EAST TO GOSHEN; THENCE NORTH TO MOUNT SUNAPEE.

	Feet.
Newport, 5.4 miles south of, 10 feet north of road at East Unity, 50 feet east of crossroads, in top of ledge; aluminum tablet stamped "1200 ADJ"	1,200.391
East Unity, 3.9 miles southeast of, 100 feet from crossroads, on top of small stone post; point	1,020.08
East Unity, 5.1 miles southeast of, 140 feet south of crossroads, 20 feet west of road, in small bowlder; aluminum tablet stamped "1297 ADJ"	1,297.756
Goshen, 5.3 miles north of, near road forks south and east, in southwest corner of red brick house of Joseph Snow; aluminum tablet stamped "1408 ADJ"	1,407.903

NEWBURY, NORTH ALONG HIGHWAYS TO GEORGES MILLS; THENCE WEST TO CROYDON; THENCE SOUTH TO NORTHVILLE.

Newbury, 3.2 miles north of, at Farmers Corners crossroads, 10 feet north of road, in small bowlder; aluminum tablet stamped "1293 ADJ"	1,292.870
Newbury, 5.9 miles north of, 10 feet from center of crossroads at Goings Corners, in bowlder; aluminum tablet stamped "1193 ADJ"	1,193.282
Georges Mills, 275 feet east of crossroads, opposite E. Austin's house, 50 feet north of road, in small bowlder; aluminum tablet stamped "1133 ADJ"	1,133.546
Georges Mills, 3.7 miles north of, junction of roads west and south called Osborns Corners, 6 feet north of west road, in bowlder; aluminum tablet stamped "1143 ADJ"	1,148.662
Croydon, junction of roads south and east, opposite Gilman's store, 12 feet north of Mr. Sargent's house, in small bowlder; aluminum tablet stamped "912 ADJ"	912.591
Croydon Flat, 20 feet north of road, 150 feet west of crossroads, in bowlder; aluminum tablet stamped "806 ADJ"	806.042

CLAREMONT QUADRANGLE.

KELLEYVILLE, WEST AND NORTH ALONG BOSTON AND MAINE RAILROAD, VIA CLAREMONT JUNCTION, TO WINDSOR, VT. (DOUBLE-RODDED LINE).

Claremont, 2.1 miles west of Chandler flag station, 75 feet north of track, on property of Dennis Cutting, in top of bowlder; aluminum tablet stamped "566 ADJ"	566.309
Claremont, in west entrance of town hall, in southeast corner of top step; aluminum tablet stamped "560 ADJ"	560.881
Claremont Junction, 400 feet north of station, 10 feet east of tracks, in top of milepost "W. R. Jc. 22" (one side) and "S 101" (other side); aluminum tablet stamped "478 ADJ"	478.221
Claremont, 0.25 mile south of town line of Cornish, 0.7 mile south of Balloch station, 30 feet west of track, 35 feet northeast of A. W. Lamberton's house, in small flat bowlder; aluminum tablet stamped "368 ADJ"	367.936

HANOVER QUADRANGLE.

HANOVER, EAST ALONG HIGHWAYS TO ETNA; THENCE SOUTH TO LEBANON; THENCE WEST ALONG BOSTON AND MAINE RAILROAD TO WHITE RIVER JUNCTION.

Hanover, at corner of College and School streets, in top of sill at northeast corner of front wall of small brick building; aluminum tablet stamped "530 ADJ"	530.376
Hanover, 2 miles east of, 170 feet east of M. C. McCabe's house, 12 feet south of road, in top of large flat bowlder; aluminum tablet stamped "594 ADJ"	594.984

	Feet.
Lebanon, at main entrance to town hall, in top of rectangular block of stone; aluminum tablet stamped "594 ADJ"	594. 193

NORTH HARTLAND, SOUTHEAST ALONG HIGHWAYS TO MERIDEN; THENCE WEST TO PLAINFIELD; THENCE SOUTH TO WINDSOR.

Meriden, 2.8 miles northwest of, at Pratts Corners, 30 feet northwest of J. L. Pratt's house, in top of small bowlder; aluminum tablet stamped "652 ADJ"	652. 851
Meriden, 100 feet east of Asa Walker's house, 15 feet north of main road, in top of large ledge; aluminum tablet stamped "925 ADJ"	925. 407
Meriden, 2.5 miles west of, on Meriden-Plainfield stage road, at junction of road south and west, 340 feet east of D. F. Morgan's house; 50 feet north of road, 10 feet south of large maple, in ledge; aluminum tablet stamped "800 ADJ"	801. 038
Plainfield, in front wall of Baptist Church, 1 foot from southeast corner; aluminum tablet stamped "528 ADJ"	528. 248

MASCONY LAKE QUADRANGLE.

HANOVER, EAST ALONG HIGHWAY TO ETNA; THENCE SOUTH TO LEBANON; THENCE ALONG BOSTON AND MAINE RAILROAD TO WHITE RIVER JUNCTION.

Etna, 35 feet north of road, 20 feet west of E. C. Wright's house, in top of small bowlder; aluminum tablet stamped "782 ADJ"	782. 080
Lebanon, 2.5 miles north of, 440 feet south-southeast of log cabin, in top of large bowlder; aluminum tablet stamped "652 ADJ"	652. 470

Whitefield quadrangle.

COOS AND GRAFTON COUNTIES.

The elevations in the following list, republished from the Nineteenth Annual Report, are based on a bronze tablet set in the west face of stone foundation of McKean Block, Whitefield, facing the public square, marked "W 952", which in turn is based on the top of rail in front of center of Boston and Maine Railroad station, Whitefield, 948 feet. Accordingly the height of the bronze tablet is accepted as 952.419 feet.

The leveling was done in 1897 by Walter R. Harper.

WHITEFIELD, ALONG BOSTON AND MAINE RAILROAD TO HAZEN JUNCTION.

	Feet.
Whitefield, opposite Boston and Maine Railroad station; top of rail	948. 00
Hazen Junction; top of rail	1, 036. 69

HAZEN JUNCTION, ALONG MAINE CENTRAL RAILROAD VIA QUEBEC JUNCTION, TO WAUMBEK JUNCTION.

Hazen Junction; top of rail	1, 038. 40
Waumbek Junction, at intersection of tracks of the Maine Central and the Boston and Maine railroads; top of rail	1, 109. 61

WAUMBEK JUNCTION, ALONG MAINE CENTRAL RAILROAD VIA RIVERTON, TO LANCASTER.

Waumbek Junction, 200 feet north of intersection of tracks; copper bolt in west side of north abutment of small bridge, stamped "W 1105"	1, 105. 356
Riverton, opposite station; top of rail of main track	1, 045. 58
Riverton, 20 feet east of and 4 feet south of station, between station and highway; copper bolt in rock ledge, stamped "W 1044"	1, 044. 533

	Feet.
Lancaster, opposite ticket-office window, Maine Central Railroad station; top of rail, main track	886.81
Lancaster, entrance to Coos County court-house; southeast corner second granite step	861.49

LANCASTER, WEST ACROSS CONNECTICUT RIVER; THENCE SOUTHWEST ON VERMONT SIDE VIA LUNENBERG BRIDGE, TO WHITEFIELD.

Lancaster, in wall of county court-house, north of entrance; bronze tablet stamped "864 W"	863.610
Lancaster, 1 mile west of, floor of highway bridge over Connecticut River	848.0
Scott, at junction of tracks of the Maine Central and the Boston and Maine railroads; top of rail	861.55
Whitefield, Maine Central Railroad, opposite west line of railroad station; top of rail	948.06

WHITEFIELD, ALONG BOSTON AND MAINE RAILROAD, VIA WING ROAD AND BETHLEHEM JUNCTION, TO TWIN MOUNTAIN.

Whitefield, McKean Block, in west face of stone foundation at northwest corner of building; bronze tablet stamped "952 W"	952.419
Whitefield Junction, opposite east side of station; top of rail	950.60
Wing road, 100 feet east of station, in top of stone or retaining wall at west side of small triangular pond between tracks, back of water tank; copper bolt stamped "1005 W"	1,004.695
Bethlehem Junction, at north line of station; top of rail	1,109.14
Bethlehem Junction, east side of north abutment of covered railroad bridge (Bethlehem branch) over Ammononoosuc River; copper bolt stamped "U S G S 1108 Ft. W."	1,188.233
Twin Mountain, opposite west line of Boston and Maine Railroad station; top of rail	1,373.33

TWIN MOUNTAIN, ALONG MAINE CENTRAL RAILROAD, TO QUEBEC JUNCTION.

Twin Mountain, opposite Maine Central station; top of rail	1,449.68
Twin Mountain, 10 feet north of steps leading up to Maine Central Railroad station, 42 feet north by 30 feet west of station, west side of track of Maine Central Railroad; copper bolt in large bowlder, stamped "1439 W"	1,438.973

Gorham and Milan quadrangles.

COOS COUNTY.

The elevations in the following list of bench marks established by the water-resources branch of the United States Geological Survey in 1906 under the general direction of H. K. Barrows, district engineer, were determined by a double-rodded line extended from Augusta, Me., to Brunswick, Me., and thence up the Androscoggin River to Errol, N. H., and are based on mean sea-level determined by a gage bench mark at Portland, Me. For a more detailed description of this line see Maine list (p. 7).

The leveling was done in 1906 by C. Robert Adams and T. W. Norcross.

Primary leveling by the water-resources branch extended from Augusta, Me.

FROM LIVERMORE FALLS, ALONG THE PORTLAND AND RUMFORD FALLS AND THE GRAND TRUNK RAILWAYS AND HIGHWAYS UP ANDROSCOGGIN RIVER, TO ERROL.

Distance in miles.	Location and description of bench mark.	Elevation in feet.
	GORHAM QUADRANGLE.	
64.0	Shelburne, 0.25 mile south of, in east corner of north bridge, seat of Grand Trunk Railway bridge over Clement Brook; aluminum tablet	704.692
69.8	Gorham station, 0.25 mile below, in north corner of east abutment of Grand Trunk Railway bridge over Peabody River; aluminum tablet	781.017
71.5	Moose River, on northwest corner of west abutment of plate-girder bridge; point marked "U S G S T B M"	808.703
73.1	Pulsifer Falls, at foot of, 800 feet south of Malloy place, 50 feet west of river, 150 feet north of south line of International Paper Company, on shore, in bowlder; iron pin	818.164
75.1	Cascade mill of the Berlin Mills Company, a few feet south of wasteway leading from log pond, in foundation at northwest corner of red barn on east side of highway; chiseled cross	890.504
75.4	Cascade mill of the Berlin Mills Company, 40 feet west of head gatehouse, in ledge; aluminum tablet	909.096
76.7	Berlin, southwest corner of International Paper Company's office building on Main street, in concrete foundation; aluminum tablet	992.586
77.9	New steel bridge on left bank of river, a few feet below the concrete abutment, at Berlin Mills Company lumber yard; aluminum tablet	1,083.866
	MILAN QUADRANGLE.	
85.2	Milan, post-office building, 27 feet from southeast corner, in south foundation; aluminum tablet	1,133.675
91.0	Pontook dam, 50 feet below, on right bank of river, 20 feet from shore, in bowlder; bolt (International Paper Company's bench mark)	1,160.099
94.5	Dummer-Errol road, south of, on side hill about 250 feet down from house of Howard (the last house before entering the 13-mile woods), in small bowlder partly split by drill; aluminum tablet	1,191.382
108.5	Errol dam, 22 feet from gristmill, in ledge; copper bolt	1,262.724
108.5	Errol dam, north of road, in highest point on ledge north of gatehouse; aluminum tablet	1,275.998

VERMONT.

PRECISE LEVELING.

Hanover, Thetford, and Woodsville quadrangles.

ORANGE AND WINDSOR COUNTIES.

The elevations in the following list are the Vermont portion of the results of the line of precise levels run in 1906 by N. A. Campbell from Portland, Me., northwest along the Maine Central Railroad and highways to the Maine-New Hampshire state line; thence across the State of New Hampshire via Lake Winnepesaukee to South Newbury, Vt.; thence south along the Boston and Maine Railroad to White River Junction. For additional statement, see New Hampshire list (p. 34).

WOODSVILLE QUADRANGLE.

SOUTH NEWBURY, SOUTH ALONG BOSTON AND MAINE RAILROAD, TO BRADFORD.

	Feet.
South Newbury, 0.8 mile southwest of, in bridge abutment; aluminum tablet stamped "400"	400.152
South Newbury, in front of station; top of rail	407.1
South Newbury, 2.6 miles southwest of, east of track, in rock; aluminum tablet stamped "406"	405.716

THETFORD QUADRANGLE.

BRADFORD, SOUTH ALONG BOSTON AND MAINE RAILROAD, TO POMPANOOSUC.

	Feet.
Bradford, in front of station; top of rail	405.2
Piermont, in front of station; top of rail	430.3
Piermont, 1.5 miles southwest of, east of track, at foot of embankment; aluminum tablet stamped "438"	438.264
Piermont, 3.3 miles southwest of, west of track, in rock ledge; aluminum tablet stamped "441"	440.500
Fairlee, in front of station; top of rail	435.5
Fairlee, 1.6 miles southwest of, west of track, in rock; aluminum tablet stamped "414"	413.635
Ely, in front of station; top of rail	430.6
North Thetford, in front of station; top of rail	396.2
North Thetford, 0.1 mile southwest of, in abutment of iron bridge over river; aluminum tablet stamped "399"	398.486
Thetford, in front of station; top of rail	408.3
Thetford, 1.6 miles southwest of, east of track, edge of right of way; iron post stamped "402"	401.716
Pompanoosuc, in front of station; top of rail	392.1
Pompanoosuc, 0.3 mile southwest of, northwest end of railroad bridge; aluminum tablet stamped "392"	392.259

HANOVER QUADRANGLE.

POMPANOOSUC, SOUTH ALONG BOSTON AND MAINE RAILROAD, TO WHITE RIVER JUNCTION.

Pompanoosuc, 3.25 miles southwest of, 25 feet east of track; iron post stamped "400"	399.952
Hanover, in front of station; top of rail	402.6
Hanover, 0.8 mile southwest of, east of track, in rock; aluminum tablet stamped "412"	411.709
Wilder, at side entrance to public library, in top of stone doorsill; aluminum tablet stamped "ADJ 430"	430.449
Wilder, in front of station; top of rail	408.7
White River Junction, on step of Catholic Church	365.85
White River Junction, in wall of Catholic Church; aluminum tablet stamped "367"	367.527

PRIMARY LEVELING.

Claremont and Hanover quadrangles.

WINDSOR COUNTY.

The elevations in the following list were determined by primary leveling extended from and including portions of the double-rodded line of levels begun at Portsmouth, N. H., in 1903 and continued in 1904 and 1905 to West Hartford, Vt. These elevations have been adjusted in conjunction with the precise-level line from Portland, Me., joining this list at White River Junction.

The leveling in Claremont quadrangle and part of Hanover quadrangle was done by W. A. Anderson in 1905. The remainder of the work in Hanover quadrangle was done by G. M. Dimmick in 1906.

CLAREMONT QUADRANGLE.

AT WINDSOR.

	Feet.
Windsor, in west wall of M. E. Church, at corner of South Main and Dursley avenues, 15 feet from corner of building, 2 feet above ground; aluminum tablet stamped "354 ADJ"	354. 011

HANOVER QUADRANGLE.

WINDSOR, ALONG CENTRAL VERMONT RAILWAY TO WEST HARTFORD (DOUBLE-RODDED LINE).

Hartland, 250 feet west of track, in road fork near station, in bowlder 15 feet north of road; aluminum tablet stamped "441 ADJ"	441. 825
North Hartland, 600 feet west of station, 50 feet north of road, 20 feet east of house, on property of William Walker, in top of small bowlder; aluminum tablet stamped "383 ADJ"	383. 325
North Hartland, 1.1 miles north of station, 540 feet north of milepost "Windsor 11 miles," 15 feet east of track, in top of small bowlder; aluminum tablet stamped "349 ADJ"	349. 603
White River Junction, in Catholic Church, near corner of Gate street, southeast corner of front wall, 8 feet south of doorway; aluminum tablet stamped "367 ADJ"	367. 527
Hartford, 2.8 miles west of station, 0.1 mile east of house of Henry Shoch on his property, 120 feet east of road, 410 feet south of track, in top of small bowlder; aluminum tablet stamped "433 ADJ"	433. 967
West Hartford, opposite station, 50 feet north of station, 25 feet north of tracks, in projection from ledge, 1 foot above ground; aluminum tablet stamped "420 ADJ"	420. 485

WHITE RIVER JUNCTION, NORTH ALONG CENTRAL VERMONT RAILWAY, TO NORWICH.

White River Junction, opposite state treasury; top of hydrant	364. 86
Wilder, at side entrance of public library, in top of stone doorsill; aluminum tablet stamped "ADJ 430" (recovered by precise levels)	430. 449
Norwich, near corner of Mechanic and Main streets, in front wall of red brick house owned by Lewin, 10 feet west of doorway; aluminum tablet stamped "536 ADJ"	536. 289

WEST HARTFORD, SOUTH ALONG HIGHWAYS, VIA TAFTSVILLE, TO HARTLAND.

West Hartford, 3.7 miles south of, town of Hartland, in foundation wall of brick schoolhouse, south end of west face; aluminum tablet stamped "941 ADJ"	941. 951
West Hartford, 6.1 miles south of, in foundation of farm house, south end of east face; aluminum tablet stamped "631 ADJ"	631. 339
Taftsville, 9.2 miles south of West Hartford, in brickwork of residence of W. H. Taft, west end of south wall, 9 bricks above foundation wall; aluminum tablet stamped "668 ADJ"	669. 030
Taftsville, 2.9 miles south of, 60 feet east of center of highway, 40 feet south of schoolhouse, in rock; aluminum tablet stamped "954 ADJ"	954. 993
Hartland Four Corners, 7.3 miles south of Taftsville, in brickwork of Universalist Church, east end of north face; aluminum tablet stamped "637 ADJ"	637. 497
Hartland station, 2.6 miles east of Hartland Four Corners, 250 feet west of track, in road fork near station, 15 feet north of road, in bowlder; aluminum tablet stamped "441 ADJ"	441. 825

Whitefield quadrangle.

ESSEX COUNTY.

The elevation given below is based on a bronze tablet set in the west face of a stone foundation of McKean Block, Whitefield, facing the public square, and marked "W 952," which in turn is based on the top of rail in front of center of Boston and Maine Railroad station, Whitefield, 948 feet. Accordingly the height of the bronze tablet is accepted as 952.419 feet.

The leveling was done by Walter R. Harper in 1897.

AT LUNENBERG STATION.

	Feet.
Lunenberg Bridge, Maine Central Railroad covered bridge over Connecticut River; copper bolt in top of west end of south retaining wall at Vermont end, stamped "846 W"	845.748

Burlington, Brandon, Camels Hump, Middlebury, Milton, Potato Hill, and Ticonderoga quadrangles.

ADDISON, CRITTENDEN, AND RUTLAND COUNTIES.

The elevations in the following list are based on the 1903 adjusted elevations of bench marks at Ticonderoga and Rouse Point, N. Y., established by the Coast and Geodetic Survey in 1882 and recovered by leveling done under the Deep Waterways Board in 1898 and 1899. The bench mark at Ticonderoga is the bottom of a hole in chiseled circle at southeast corner of north stone abutment of Delaware and Hudson bridge No. 19 over Ticonderoga Creek, and its accepted elevation by the 1903 adjustment is 109.368 feet above mean sea level. The bench mark at Rouse Point is on the water table, north side of Chapman Block, 20.6 feet west of the northeast corner, and consists of a cross and circle, the elevation of which is now accepted as 107.95 feet above mean sea level.

A series of simultaneous gage comparisons was made for seventeen days—June 14–30, 1904—by A. D. Butterfield and H. K. Barrows, of the University of Vermont, between Fort Montgomery, N. Y., and Burlington, Vt., and the elevation thus obtained at Burlington was about 0.3 foot less than that brought from Ticonderoga through primary circuits. The elevations herein given for Burlington quadrangle are based directly on the gage determination, and the error is adjusted in leveling in Ticonderoga and Middlebury quadrangles.

The leveling was done as follows: In Brandon and Ticonderoga quadrangles by George Bailey in 1902; in Middlebury quadrangle by F. M. Goodhue and A. T. Paine in 1903; and in Burlington quadrangle by A. T. Paine in 1904.

TICONDEROGA QUADRANGLE.

FORT TICONDEROGA, N. Y., EAST ALONG DELAWARE AND HUDSON RAILROAD, TO WHITING, VT.

	Feet.
Huffs Crossing, 400 feet east of, iron bridge over creek; west end of north abutment	217.79

BRANDON QUADRANGLE.

WHITING, SOUTH ALONG HIGHWAYS, TO SUDBURY (SINGLE SPUR LINE).

Sudbury, northwest corner of church at road corners, on outcrop of rock; bronze tablet stamped "572 ALBANY"	572.289

WHITING, SOUTHEAST ALONG RAILROAD VIA LEICESTER JUNCTION, TO BRANDON; THENCE NORTHEAST ALONG HIGHWAY, TO FORESTDALE.

Leicester Junction, at road crossing; top of rail	353
Brandon, bridge over creek between town hall and First National Bank, in top of west side wall; aluminum tablet stamped "414 ALBANY"	416.438

BRANDON, SOUTHEAST ALONG RAILROAD 3.6 MILES (SINGLE SPUR LINE).

Brandon, 3.36 miles south of, railroad bridge over Otter Creek, north abutment, 4.7 feet east of east rail, 1.3 feet below rail; mark	362.04

FORESTDALE, NORTH ALONG HIGHWAYS, TO EAST MIDDLEBURY; THENCE WEST TO CORNWALL; THENCE SOUTH TO WHITING.

Salisbury, 0.5 mile east of, south side of road corners, 2 feet above ground; bronze tablet stamped "548 ALBANY"	547.685
Cornwall, 3 miles east of, bridge over Otter Creek, on northwest abutment; cut	349.54
Cornwall, in west wall of town hall, just south of door, 1 foot from ground; aluminum tablet stamped "374 ALBANY"	374.231

FORESTDALE, NORTHEAST ALONG HIGHWAYS, TO GOSHEN (SINGLE SPUR LINE).

Goshen, in south end of east wall of meeting house; bronze tablet stamped "1136 ALBANY"	1,135.820

EAST MIDDLEBURY, ALONG HIGHWAYS, TO RIPTON.

East Middlebury, 0.75 mile east of, at road corners	782.51
Ripton, north side of highway, bridge over creek, in west abutment; bronze tablet stamped "1017 ALBANY"	1,016.997

POTATO HILL QUADRANGLE.

SOUTH LINCOLN TO LINCOLN.

South Lincoln, 0.75 mile west of, in northwest angle at junction of the South Lincoln and the Lincoln-Ripton roads, in top of granite bowlder, 3.5 feet above ground; bronze tablet stamped "1249 MONTPELIER"	1,249.300
Lincoln, opposite Lincoln Lumber Company's store, in east abutment of iron bridge, south side of roadway, on bridge seat, 15 feet below floor of bridge; aluminum tablet stamped "971 MONTPELIER"	971.365

MIDDLEBURY QUADRANGLE.

RIPTON, NORTH ALONG HIGHWAYS TO SOUTH LINCOLN.

Ripton, 3.5 miles north of, 75 feet east of bridge over brook, at road fork by Fisher district schoolhouse, in northwest angle at top of retaining wall; on large flat stone; point	1,415.31

LINCOLN, WEST ALONG HIGHWAY TO BRISTOL.

	Feet.
West Lincoln, at north end of iron bridge, east side of north abutment; point on bowlder	890.19

CORNWALL, NORTH ALONG HIGHWAY AND RUTLAND RAILROAD VIA MIDDLEBURY TO NEW HAVEN; THENCE EAST TO BRISTOL.

Middlebury, in marble underpinning of Battel Block, at middle of bay window at northeast corner of block, 18 inches from sidewalk; aluminum tablet stamped "366 MONTPELIER"	366.080
Belden, in front of station, 6 feet to right of track; point on limestone outcrop	329.71
Brooksville, at south end of iron railway bridge over New Haven River, southeast corner of squared limestone in east side of south abutment; top of second course	299.15
New Haven, in foundation of brick Congregational Church, in north face, 4 feet from northwest corner (corner stone), 15 inches above ground; aluminum tablet stamped "454 MONTPELIER"	454.021
Bristol, in north face of foundation of town hall (Holley Hall), 18 inches from northeast corner, 1 foot from ground; bronze tablet stamped "570 MONTPELIER"	570.422

NEW HAVEN, NORTH ALONG RUTLAND RAILROAD TO FERRISBURG; THENCE EAST ALONG HIGHWAY TO MONKTON; THENCE SOUTH TO BRISTOL.

Ferrisburg, in foundation of red brick town hall, 10.9 feet from southwest corner of south side, 2.5 feet from ground, in small rectangular limestone; aluminum tablet stamped "217 MONTPELIER"	217.268
Monkton, at four corners, opposite Ladd's Hotel, 500 feet from creamery, on northeast corner of road intersection, in large round rock with flat top; aluminum tablet stamped "533 MONTPELIER"	532.775

BURLINGTON QUADRANGLE.

MONKTON, NORTHWEST ALONG HIGHWAY TO NORTH FERRISBURG; THENCE NORTH ALONG HIGHWAY TO BURLINGTON.

North Ferrisburg, 300 feet from post-office, in northwest corner of foundation of Joseph L. St. Peter's general store, in center of a rectangular sandstone; aluminum tablet stamped "168 MONTPELIER"	167.739
Charlotte, 0.25 mile east of post-office, 25 feet west of three forks forming south point of small triangle of roads, in small flat bowlder with round top; aluminum tablet stamped "253 MONTPELIER"	252.532
Shelburne, in northwest corner of foundation of Methodist Church, 2 feet from ground, 6 feet from northwest corner; aluminum tablet stamped "174 MONTPELIER"	173.468
Queen City Park, 1.7 miles south of, at northeast angle of three corners, about 100 feet southwest of Spears farmhouse, in small bowlder with flat top; aluminum tablet stamped "171 MONTPELIER"	170.443
Lake Champlain, at wharf of the Champlain Transportation Company, July 25, 1904; surface of water	94.39
Burlington, city hall, on south side of front steps facing park, in large rectangular granite capstone, 6 feet above ground; aluminum tablet stamped "208 MONTPELIER"	208.012

MONKTON, NORTHEAST ALONG HIGHWAY TO SOUTH HINESBURG; THENCE NORTH VIA HINESBURG TO WILLISTON; THENCE SOUTHEAST TO RICHMOND.

	Feet.
South Hinesburg, in front foundation of P. McDonough's barn, opposite cheese factory, 900 feet north of road to Monkton, 25 feet east of main road, 1 foot from ground; aluminum tablet stamped "433 MONTPELIER"	433.248
Hinesburg, north side of town hall, at west edge of marble step, 1 foot above ground; aluminum tablet stamped "344 MONTPELIER"	343.615
Williston, 4 miles southwest of, 4 miles north of Hinesburg, at three corners, 150 feet northwest of red brick schoolhouse, west of road, in large flat slaty bowlder; aluminum tablet stamped "725 MONTPELIER"	724.494
Williston, in southeast corner of front foundation of Methodist Church, 2.5 feet from ground, in small rectangular brownstone; aluminum tablet stamped "501 MONTPELIER"	500.472

BURLINGTON, NORTHEAST ALONG CENTRAL VERMONT RAILWAY TO FORT ETHAN ALLEN; THENCE SOUTHEAST TO RICHMOND.

Essex Junction, in foundation of red brick high school, near railroad station, on southeast corner of building, in small rectangular sandstone; aluminum tablet stamped "358 MONTPELIER"	357.532
North Williston, 150 feet east of station, north of track, opposite red brick gristmill, in middle of bowlder, 1.5 feet above ground; aluminum tablet stamped "305 MONTPELIER"	304.996

CAMELS HUMP QUADRANGLE.

AT RICHMOND.

Richmond, about 600 feet south of station, south of railroad track, in northeast corner of foundation of Universalist Church, in small rectangular red sandstone, 15 feet above ground; aluminum tablet stamped "319 MONTPELIER"	318.550

MILTON QUADRANGLE.

AT FORT ETHAN ALLEN.

Fort Ethan Allen, 100 feet east of station, 10 feet from track, in rectangular sandstone, 2 feet above ground; aluminum tablet stamped "309 MONTPELIER"	308.801

Bennington quadrangle.

BENNINGTON COUNTY.

The elevations in the following list, reprinted from Appendix to Eighteenth Annual Report, are based on a bronze tablet set in the water table at front door of the county court-house in Bennington, marked "U. S. Geological Survey; elevation 682 feet; B. M." The elevation of this bench mark above mean sea level is based on the top of rail of the Rutland Railroad in front of the railroad station at South Shaftsbury, the height of which is accepted as 720 feet, as brought by careful spirit levels from the Delaware and Hudson Railroad at Lake Champlain and adjusted thence through from sea level. In accordance with this height, the elevation of the central datum, the bronze tablet in Bennington, is accepted as 681.611 feet.

The leveling was done by E. L. McNair and A. B. Pomme in 1896.

AT BENNINGTON.

	Feet.
Bennington, in water table at front door of county court-house; bronze tablet stamped "682"	681. 611
Main and Bradford streets, corner of south end of stone wall; chiseled circle.	752. 40

BENNINGTON, TO BENNINGTON MONUMENT.

Bennington, near convent school, at foot of Monument Hill, on stone south of road, 25 feet east of culvert on west Main street; square chisel mark	663. 41
Bennington monument, on northwest corner of doorsill; chisel mark	869. 97
Bennington monument, at left side of entrance doorway; bronze tablet stamped "873"	873. 181

BENNINGTON, VIA HEARTWELLVILLE, TO STAMFORD.

John Wilson's house, south of road, beside board fence, at east end of bars opening into yard, on small bowlder; chiseled circle	884. 75
John Rooney's house, 50 feet above gate leading to, on top of large bowlder beneath board fence; chiseled circle	1, 217. 93
Woodford, 2 miles west of, on side of road next to stream; bowlder marked with chiseled circle	1, 601. 43
Woodford, 43.5 feet from northwest corner of church, on line with front of church, in large flat bowlder nearly embedded in ground; copper bolt marked "U S G S 2,215 Ft. B. M."	2, 215. 076
Woodford, 2 miles east of, 160 feet from small wooden bridge, 10 feet south of road, on top of large bowler nearly embedded in ground; chiseled circle	2, 319. 59
Woodford, 5 miles east of, summit of hill surmounted by house, on bowlder near corner of barn; round chisel mark	2, 267. 71
Heartwellville, 2.5 miles north of, about 10 feet east of center of road, 660 feet east of summit of hill, on bowlder; chiseled circle	2, 446. 01
Heartwellville, east of post-office, 2,100 feet west of Canedy's Hotel, at right of road, in large bowlder; copper bolt stamped "U S G S 1,784 Ft. B. M.".	1, 783. 822
Deerfield River, road fork, 850 feet south of bridge, on large bowlder; chiseled circle	1, 831. 63
Iron bridge, north end of east side, 5 feet from corner, on top of east wall of rock abutment; chiseled circle	1, 363. 13
Bennett S. Cole's house, 1,000 feet north of, in meadow at right of road nearly in line with telegraph poles, on top of large bowlder deeply embedded in ground; chiseled circle	1, 233. 10
Stamford, Methodist Episcopal parsonage, in doorstep of front porch; copper bolt stamped "U S G S 1,131 Ft. B. M."	1, 130. 762

WOODFORD HOLLOW, TOWARD GLASTENBURY.

Camp Comfort, opposite, 100 feet east of sawmill, 100 feet north of road, on top of large bowlder; chiseled circle	1, 266. 82
Electric railway power house, 2.5 miles from, 10 feet from corner of stable (last building before reaching old town of Glastenbury); copper bolt in bowlder containing about 1 cubic yard, stamped "U S G S 1,672 B. M."	1, 671. 761

BENNINGTON, VIA POWNAL CENTER, TO POWNAL.

Bennington, 0.5 mile south of, east of road at culvert, close to two ash trees, 300 feet north of two dwellings, on large bowlder; square chisel mark	805. 03
Bennington, 4.5 miles south of, at Dave Towslee's house, under butternut tree in front of house, on bowlder; square chisel mark	950. 28

	Feet.
Bennington, 5 miles south of, at Pine Hill, intersection of road to east, just north of Pine Hill, in stone in northeast corner; square chisel mark	968.93
Pownal Center church, 14.75 feet north of northwest corner, in line with front, in rock; copper bolt stamped "U S G S 986 Ft. B. M."	985.676
Pownal, Main street crossing of Boston and Maine Railroad; top of north rail	548.55

SOUTH SHAFTSBURY, TO BENNINGTON.

South Shaftsbury, in foundation stone of west abutment, north wing of bridge over small brook; copper bolt stamped "U S G S 711 Ft. B. M."	710.83
South Shaftsbury, 1 mile south of, on top of corner stone of stone fence in southeast corner of road east, opposite house with 6 black-ash trees in front; square chisel mark	788.09
Bennington, 3 miles north of, 300 feet north of brick schoolhouse, at intersection of road east, on lowest stone in southeast fence corner; square chisel mark	788.87
Bennington monument, 1 mile north of, bridge over Furnace Brook, on top of coping of north abutment; square chisel mark	585.44

INDEX.

A. Page.

Abol Carry 32
Abol Falls 32
Abol Stream 32
Adams, C. R., work of 28, 45
Albany 18
Albany Corners 18
Alexander, C. K., work of 16, 20
Allagash Lake 33
Allagash Stream 33
Ambajejus Falls 32
Ambajemackomus Falls 32
Amherst 41
Amoskeag 39
Anderson, W. A., work of 38, 47
Androscoggin River bridge 29
Anson 11
Anson quadrangle 11-12
Ashland 35
Askwith 31
Auburn 14
Augusta 10, 28
Augusta quadrangle 10, 28
Austin Pond 12

B.

Babbett & Googin dam 13, 29
Baboosic 41
Bailey 49
Baldwin, D. H., work of 6
Bangor 20
Bangor quadrangle 20-21
Bath quadrangle 9, 28
Bedford 41
Belden 51
Belfast 18, 19
Belfast quadrangle 18
Bennington 53, 54
Bennington quadrangle 52-54
Benton quadrangle 36
Bethel 18
Bethel quadrangle 18, 29
Bethlehem Junction 45
Big Eddy 32
Bingham 12
Bingham quadrangle 12
Bluehill 23
Bluehill quadrangle 23
Boardman, H. S., work of 28, 30
Boscawen quadrangle 37
Bowdoinham 28
Bow Junction 39
Bowlin Falls 34
Bradford 42, 47
Brandon 50
Brandon quadrangle 50

Page.

Brassua Lake 31
Brassua Lake quadrangle 13
Brett, G. M., work of 30
Bridgewater 35
Bridgton Junction 16
Briggs Ferry 12
Bristol 37, 51
Brooksville 51
Brownfield 16
Brunswick 9, 28
Buckfield 15
Buckfield quadrangle 15, 29
Bucksport 20
Bucksport Center 20
Bucksport quadrangle 20
Burlington 51
Burlington quadrangle 51-52

C.

Camden 19
Campbell, N. A., work of 8
Camp Comfort 53
Campton quadrangle 35
Candia 39
Caratunk 12
Cascade mill 46
Castine quadrangle 19
Center Harbor 36
Center Lovell 17
Centerville 34, 35
Charlotte 51
Cherryfield 25, 26
Cherryfield quadrangle 25-26
Chester 40
Chesuncook 30
Chesuncook Lake 31
Chisholm 29
Claremont 43
Claremont Junction 43
Claremont quadrangle 43, 48
Clifton 22
Coe, Robert, work of 19, 20
Concord 39
Concord quadrangle 39-40
Contoocook 39
Cornish 9, 16
Cornwall 50
Costigan 23
Crowleys 14
Crowleys Junction 14
Croydon 43
Croydon Flat 43
Cumberland Junction 8
Cumberland Mills 8
Cutter 27
Cutter quadrangle 27

D. Page.

Deadwater 12
Debsconeag Deadwater 32
Debsconeag Falls 32
Dedham 22
Deering Junction 8
Deering River 53
Dennysville 26,27
Derry 40
Dimmick, G. M., work of 47
Dimond 42
Dingley farm 13,29
Dixfield quadrangle 29
Douglas, E. M., work of 6
Drury 42
Drummer-Errol dam 46

E.

Eastbrook Corners 21
East Brownfield 16
East Bucksport 23
East Eddington 22
East Freedom 34
East Fryeburg 17
East Haverhill 36
East Hebron 15
East Northport 19
East Middlebury 50
East Orland 22
East Peru 29
Eastport 27
Eastport quadrangle 26–27
East Stoneham 17
East Tilton 37
East Unity 43
Edgerly, J. W., work of 19,20
Effingham Falls 34
Ellingwoods Corner 20
Ellsworth 21
Ellsworth Falls 21,22
Ellsworth quadrangle 21–22
Elmwood 41
Elmwood Farm 14
Ely 47
Embden Center 12
Enfield 24
Epping 26,39
Errol dam 46
Essex Junction 52
Etna 44

F.

Fairlee 47
Farmington 29
Ferrisburg 51
Fish Hatchery 34
Fort Constitution 38
Fort Ethan Allen 52
Foxhole Rips 30
Franklin 21
Freedom 34
Freeport 9
Freeport quadrangle 8–9,29
Fryeburg 16
Fryeburg Center 17
Fryeburg quadrangle 16–17

G. Page.

Gannett, S. S., work of 6
Gardiner 28
Gardiner quadrangle 28
Gaza 37
Georges Mills 43
Gilbertville 29
Gilead 29
Gilford 37
Gilman, H. M., work of 26
Glencliff 36
Goffs Falls 40
Goffstown 40
Goodhue, F. M., work of 38,49
Goodwill 11
Gorham 46
Gorham quadrangle 46
Goshen 43,50
Grand Lake dam 33
Grasmere Junction 40
Gray quadrangle 8
Great Bay 37
Greenbush 23
Greene 14
Greenfield 41
Greenville 42
Grindstone 34
Grover, A. L., work of 30

H.

Hadley 42
Hallowell 10,28
Hanover 43,47
Hanover quadrangle 43–44,47,48
Harbor 17
Harper, W. R., work of 37,49
Harrington 26
Hartford 48
Hartland 48
Hartland Four Corners 48
Harts Corners 22
Havens, A. S., work of 20
Haverhill 36
Hazen Junction 44
Heartwellville 53
Hebron 15
Highbridge 42
Hill 37
Hillegass, E. B., work of 16
Hinckley 11
Hinesburg 52
Hiram 16
Holderness 38
Hookset 39
Hudson 21
Huffs Crossing 50
Hunt Island 34

I.

Indian Pond 12

J.

Jackman 31
Jay Bridge 29

K. Page.
Katahdin Stream........ 32
Keenes Mills Cemetery........ 15, 29
Kelleyville........ 42
Kenduskeag........ 21
Kezar Falls........ 9
Kezar Falls quadrangle........ 9, 16

L.
Laconia........ 37
Lake Champlain........ 51
Lakeport........ 37
Lakeview........ 36
Lakewood........ 21
Lancaster........ 45
Lebanon........ 44
Ledge Falls........ 34
Leeds........ 14
Leeds Junction........ 14
Leicester Junction........ 50
Levant........ 21
Lewiston........ 13, 14, 29
Lewiston Junction........ 14
Lewiston quadrangle........ 13-14, 29
Lincoln........ 24, 50
Lincoln Center........ 24
Lincoln quadrangle........ 24
Lincolnville........ 18
Lincolnville Beach........ 18
Lisbon........ 14
Lisbon Falls........ 13, 29
Livermore........ 29
Livermore Falls........ 29
Livermore quadrangle........ 15, 29
Lobster Stream........ 31
Long Pond........ 31
Lovell........ 17
Lubec........ 26
Lunenberg Bridge........ 49
Lynchville........ 17, 18

M.
Mackamp........ 31
McMaugh, F. J., work of........ 10, 13, 18, 19, 20, 23
McNair, E. L., work of........ 52
Madison........ 52
Madison Center........ 52
Maine........ 7-34
cooperation of........ 5
Manchester........ 40
Manchester quadrangle........ 40
Marrs Camp........ 13
Marshall, R. B., work of........ 5
Martins........ 39
Mascony Lake quadrangle........ 44
Massabesic........ 39
Mastyard........ 39
Mattawamkeag........ 24
Mattawamkeag quadrangle........ 24
Mattocks........ 9
Meadowview........ 29
Mechanic Falls........ 14
Medway........ 24, 25, 34
Melvin........ 36
Meredith........ 35
Meredith Center........ 37
Meriden........ 44
Merrimack........ 40
Middlebury........ 51
Page.
Middlebury quadrangle........ 50-51
Milan........ 46
Milan quadrangle........ 46
Milford........ 22, 41
Milford quadrangle........ 41
Millbridge........ 25
Millinocket........ 25
Millinocket Church........ 25
Millinocket quadrangle........ 25
Monkton........ 51
Moosehead........ 13, 31
Moosehead Lake........ 13
Moosehead Lake quadrangle........ 13
Moosehorn Stream........ 30
Moose River........ 46
Moose's crossing........ 42
Moultonboro........ 36
Mount Desert quadrangle........ 23
Mount Kearsarge quadrangle........ 42
Mount Major........ 37
Moxie Pond........ 13
Mud Pond........ 33
Mud Pond Brook........ 33

N.
Nahors........ 41
Nashua........ 40
New Boston........ 41
Newbury........ 43
Newhall........ 8
New Hampshire........ 34-46
New Hampton........ 37
New Haven........ 51
New Ipswich........ 42
Newport........ 42, 43
Newry........ 29
Nicolin........ 22
Noone........ 42
Norcross, T. W., work of........ 28, 45
Norcross Cove........ 32
Norridgewock........ 11
Norridgewock quadrangle........ 11
North Anson........ 12
North Bethel........ 18
North Bluehill........ 23
North Brookline........ 41
North Bucksport........ 20
Northeast Carry........ 31
North Ferrisburg........ 51
North Fryeburg........ 17
North Hurtland........ 48
North Lincoln........ 24
North Madison........ 11
North Newburg........ 20
Northport........ 18, 19
North Sanbornton........ 37
North Searsport........ 20
North Thetford........ 47
North Twin Lake........ 32
North Waterford........ 17
North Williston........ 52
Norway quadrangle........ 15
Norwich........ 48
Nottingham quadrangle........ 39

O.
Olamon........ 23
Oldtown........ 22
Orland quadrangle........ 22-23

Page.
Orona 22
Orona quadrangle 22
Ossipee 35
Ossipee quadrangle 35
Oxford 15

P.

Packwackamus Deadwater 32
Packwackamus Falls 32
Paine, A. T., work of 38, 49
Parker 40
Passadumkeag 24
Passadumkeag quadrangle 23–24
Passamagormuc Falls 32
Pejepscot 29
Pembroke 27
Peterboro 42
Peterboro quadrangle 41–42
Piermont 47
Pike 36
Plainfield 44
Plymouth 35
Poland 14, 15
Poland quadrangle 14–15
Poland Spring 14
Pomme, A. B., work of 52
Pompanoosuc 47
Pontook dam 46
Porter 9, 16
Portland 8
Portland quadrangle 8
Portsmouth 38
Potato Hill quadrangle 50
Pownal 54
Pownal Center 54
Prospect 20
Pulsifer 46

Q.

Queen City Park 51
Quincy 35

R.

Rands School 16
Raymond 39
Richardson 41
Richmond 28, 52
Richville 9
Rileys 29
Ripogenus Lake 31
Ripton 50
Riverton 44
Robinsons 39
Roby 42
Rockingham Junction 39
Rockland 19
Rockland quadrangle 19
Rumford Center 29
Rumford Falls 29
Rumford Junction 14
Rumford Point 29
Rumford quadrangle 18, 29
Rumney 35
Rumney quadrangle 35–36
Russell 41

S. Page.

Sabattus 14
Salisbury 50
Sanbornton 37
Sanders 37
Scott 45
Sebago 9
Sebago quadrangle 9
Second Lake 33
Shawmut 11
Shelburne 46, 51
Silver Lake quadrangle 34
Skowhegan 11
Skowhegan quadrangle 11
Snow Corner 21
Soldiers Brook 34
Solon 11
Sourdnahunk 32
South Bennington 41
South Corinth 21
South Hinesburg 52
South Lincoln 24, 50
South Newbury 46
South Orrington 20
South Paris 15
South Shaftsbury 54
South Windham 8
Spectacle Pond 42
Squam Lake 38
Squam Lake quadrangle 35, 37–38
Stair Falls 34
Stamford 53
Steep Falls 9
Steuben 25
Strickland 29
Sudbury 50
Sunapee 42
Sunapee Lake 42
Sunapee quadrangle 42–43
Suncook quadrangle 39
Surry 23
Sutton, Frank, work of 5
Swanville 18, 20
Sweden Corner 17

T.

Taftsville 48
The Arches 32
The Forks 12
The Forks quadrangle 12–13
Thetford 47
Thetford quadrangle 47
The Weirs 36
Thomaston 19
Thompson Lake 15
Ticonderoga quadrangle 50
Tilden 21
Topsham 28
Tripp Pond 15
Turner 15
Twin Lake dam 25
Twin Mountain 45

U.

Umbazooksus Lake 33
Umbazooksus Stream 33

V. Page.

Vassalboro........ 10,11
Vassalboro quadrangle........ 10-11
Vermont........ 46-54

W.

Wales........ 14
Waltham........ 21,22
Warner........ 42
Warren........ 19,36
Washington Junction........ 21
Waterville........ 11
Waterville quadrangle........ 11
Waumbek Junction........ 44
Waukawan Lake........ 35
Webster Brook........ 33
Webster Mills........ 14
Wentworth........ 36
West Alton........ 37
West Baldwin........ 16
West Bethel........ 29
West Brighton........ 17
West Concord........ 39
West Derry........ 40
West Ellsworth........ 22
West Hartford........ 48
West Lincoln........ 51
West Lubec........ 26,27
West Minot........ 14
West Oldtown........ 21
West Pembroke........ 27
West Poland........ 15
West Rockport........ 19
West Rumney........ 35,36
West Winterport........ 20
Whetstone Falls........ 34
Whitefield........ 44,45
Whitefield quadrangle........ 44-45,49
White River Junction........ 47,48
Whiting........ 26
Wilder........ 42,47
Williston........ 52
Wilson, H. M., work of........ 5
Wilton........ 41
Wilton Center........ 42
Windham Depot........ 40
Windsor........ 48
Wing road........ 45
Winn........ 24
Winn quadrangle........ 24
Winnepesaukee, Lake........ 35
Winnepesaukee quadrangle........ 35,36-37
Winslow........ 11
Woodford........ 53
Woodsville quadrangle........ 36,46

Y.

Yarmouth........ 8
Yarmouth Junction........ 8,9
York quadrangle........ 38

O

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

BULLETIN 438

GEOLOGY AND MINERAL RESOURCES OF THE ST. LOUIS QUADRANGLE

MISSOURI-ILLINOIS

BY

N. M. FENNEMAN

WASHINGTON
GOVERNMENT PRINTING OFFICE
1911

CONTENTS.

Page.

Introduction 7
  Acknowledgments 7
  Location 8
  General relations 8
  Topography 9
    The upland 9
    General features 9
    Small valleys 9
    Rock terraces 10
    Relation of topography and underlying rocks 10
  Mississippi flood plain 11
  Drainage 12
Descriptive geology 13
  Stratigraphy 13
    General section 13
    Detailed well sections 14
      Well near Monks Mound 14
      Well at the insane asylum 15
      Belcher well 17
    Ordovician system 18
      St. Peter sandstone 18
      Formations above the St. Peter sandstone 18
    Carboniferous system 19
      Mississipian series 19
        Kinderhook formation 19
        Osage group (Burlington and Keokuk limestones) 20
        Meramec group 21
          Warsaw shale 21
          Spergen limestone 22
          St. Louis limestone 23
        Chester group 24
      Pennsylvanian series ("Coal Measures") 25
        General character 25
        Cheltenham fire clay 28
        Sandstones 28
        Coal 29
    Tertiary system 30
      Lafayette gravel 30
        Composition 30
        Topographic position 31
    Quaternary system 31
      Pleistocene deposits 31
      Kansan drift 31
      Illinoian drift 32
      Loess 33
      Recent deposits 34
        Alluvium of the flood plain 34
        Terraces 34

Descriptive geology—Continued.

Page.
Structural geology........ 35
Regional dip........ 35
Local transverse folds........ 36
Geologic history........ 36
Algonkian time........ 37
Cambrian land interval........ 37
Cambro-Ordovician sedimentation........ 37
Formation of magnesian limestone........ 37
Sandstone making........ 37
Middle Ordovician epoch........ 38
Late Ordovician shale making........ 39
Silurian-Devonian land period........ 39
Carboniferous sedimentation........ 40
Mississippian time........ 40
Kinderhook epoch........ 40
Osage epoch........ 40
Warsaw epoch........ 41
Spergen epoch........ 41
St. Louis epoch........ 41
Chester epoch........ 42
Mid-Carboniferous land epoch........ 42
Pennsylvanian time........ 42
Post-Carboniferous uplift and peneplain........ 43
Lafayette epoch........ 44
Post-Pliocene uplift........ 45
Pre-Quaternary dissection........ 45
Glacial history........ 46
Kansan epoch........ 46
Illinoian epoch........ 46
Loess epoch........ 46
Wisconsin epoch........ 47
Postglacial erosion........ 48
Stage of dissection........ 48
Mississippi trough........ 48
Economic geology........ 49
Clay........ 49
Fire clay........ 49
Mining operations........ 49
Stratigraphic position........ 50
Thickness........ 50
Roof........ 50
Floor........ 50
Local interruptions........ 51
Water........ 51
Grades of clay........ 51
Uses........ 51
Distribution........ 52
Shale........ 53
Brick clay........ 53
Quarry rock........ 54
Spergen limestone........ 54
St. Louis limestone........ 54
Pennsylvanian series........ 54

Economic geology—Continued.

Page.
Lime 55
Cement materials 55
Sand and gravel 56
    Glass sand 56
    Building sand 57
    Molder's sand 57
    Cement gravel 58
Oil and gas 58
    Area in St. Louis 59
    Mississippi flood plain 61
    Region west of St. Louis 62
    Prospects 62
Coal 63
    Illinois 63
    Missouri 64
Water resources 65
    Streams and lakes 65
    Shallow wells 65
        Wells on the Mississippi flood plain 65
        Wells on the upland 66
    Cisterns 66
    Springs 67
    Deep wells 67
        Carboniferous system 67
        Ordovician system 68
    Flowing wells 68
Index 71

ILLUSTRATIONS.

Page.
Plate I. Geologic map of St. Louis quadrangle .... In pocket.
II. Sink holes south of Stolle, Ill 10
III. *A*, St. Peter sandstone, Pacific, Mo.; *B*, Cross-bedding in Spergen limestone, Meramec Highlands, Mo 18
IV. Brecciated St. Louis limestone 24
V. *A*, Loess on St. Louis limestone, one-half mile south of Stolle, Ill.; *B*, Lafayette gravel on Carboniferous shale, northwest of Glencoe, Mo 30
VI. Structure sections: *A*, From Crystal City, Mo., to point near Peters station, Ill.; *B*, From Pacific, Mo., to Monks Mound, Ill 36
Figure 1. Index map showing location of St. Louis quadrangle 8

GEOLOGY AND MINERAL RESOURCES OF THE ST. LOUIS QUADRANGLE, MISSOURI-ILLINOIS.

By N M. FENNEMAN.

INTRODUCTION.

ACKNOWLEDGMENTS.

The field work which forms the basis of this report was done in the summer of 1906 under the joint auspices of the United States Geological Survey and the State Geological Survey of Illinois. A report on the physiography of the region has been submitted to the Illinois Survey and published as Bulletin 12. The writer of this report was aided in the field by J. C. Jones, of the Illinois Survey. The geologic map is, in the main, his work. Valuable counsel and assistance were received from Profs. R. D. Salisbury and Stuart Weller, of the University of Chicago, acting as members of the Illinois Survey. Maps and data of considerable value were received from the Mississippi River Commission and the United States engineer in charge of Mississippi River.

The interest taken in the work by many citizens of St. Louis gave very material assistance in collecting important data not directly obtainable in the field. Mr. Arthur Thacher is especially to be thanked for assistance of this character. Generous help was also received from Mr. H. A. Wheeler, whose former work on the Missouri Geological Survey gave him special familiarity with the region; from Mr. George More, whose experience in bridge building put him in possession of valuable data regarding the formations beneath the channels of Mississippi and Missouri rivers; from Mr. William B. Potter, manager of the St. Louis Sampling and Testing Works, who has made many analyses of the water from this vicinity; and from Mr. Charles W. Francis, assistant health commissioner, who furnished data concerning the wells of St. Louis. The information and assistance received from numerous well drillers and managers or other officers of clay mines and factories, quarries, etc., was so varied and abundant as to preclude the mention of individual names.

The writer was at different times accompanied in the field by Dr. W J McGee, whose many suggestions were of much value. A similar acknowledgment is due to Mr. Gerard Fowke, who is familiar with the field and who accompanied the writer for several days. The mapping of the isolated patches of Illinoian drift west of the Mississippi rests in part on the work of Prof. J. A. Drushell, of the Teachers College of St. Louis.

LOCATION.

The area considered in this report is known as the St. Louis quadrangle. It is a rectangle 31 miles long from east to west and 17½ miles wide, with an area of about 535 square miles. The entire area lies south of Missouri River, which touches its extreme northwest corner. The city of St. Louis is near the center of the area, and the Mississippi divides it into two nearly equal parts. (See fig. 1.)

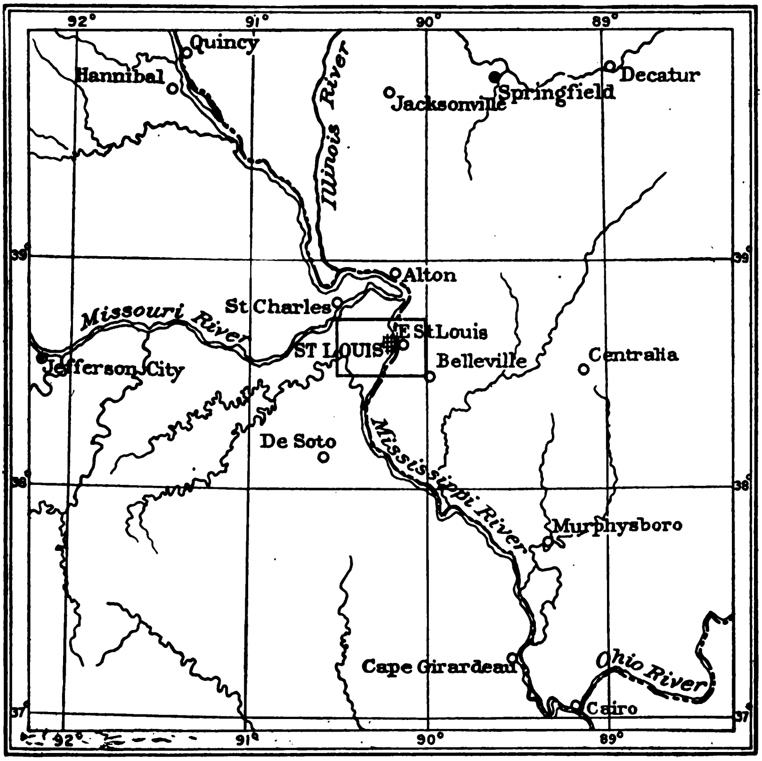


FIGURE 1.—Index map showing location of St. Louis quadrangle.

GENERAL RELATIONS.

With reference to larger geologic features this area lies at the northeast base of the Ozark structural dome, between that dome and the synclinal basin of central Illinois. The general dip of the strata within the area is therefore to the north and east. Within the Ozark Plateau erosion has laid bare rocks of Cambro-Ordovician age; in the St. Francis Mountains, from 60 to 100 miles south of St. Louis, considerable areas of pre-Cambrian rocks are exposed. In the shallow synclinal basin of Illinois even the higher Pennsylvanian coal measures have been preserved from erosion. In passing eastward and northeastward from the St. Francis Mountains the outcrops of the several Paleozoic formations are crossed.

The St. Louis quadrangle lies just outside of the glaciated area, in a reentrant angle of its margin. To the south or southeast of St. Louis the margin of the glaciated area is the edge of the Illinoian drift sheet and follows in a general way the east bluff of Mississippi River. To the west the drift sheet of the Kansan glacial epoch appears, its margin following roughly the course of the Missouri.

TOPOGRAPHY.

The major elements of the topography are (1) the remains of a gently sloping upland from 550 to 700 feet above the sea, now interrupted by small valleys to such an extent that the whole surface is gently rolling; (2) the Mississippi flood plain, about 150 feet below the upland, which crosses the area from north to south, varying in width from 3 to 10 miles and in most places separated from the upland on either side by abrupt bluffs.

THE UPLAND.

GENERAL FEATURES.

The upland, though dissected and now represented only by remnants, most of which are mere ridges, is strikingly noticeable from any elevated position. As viewed from one of the major ridges, the sky line is almost perfectly horizontal. Only at long intervals may a gentle upward curving be noted, such as that representing the broad but slight elevation in the vicinity of Stratmann or the similar rise 2 miles farther north. Perhaps the most distinct of such features is 2 miles northwest of Ballwin (a short distance west of the St. Louis quadrangle), where a hill, less than half a mile wide at the base, rises at least 50 feet above the distinctly horizontal upland, which at that place is approximately 700 feet high.

The altitude of the upland 20 miles west of St. Louis on the divide between Missouri River on the north and the Meramec on the south, is about 750 feet. Its remnants in and near St. Louis are not above 550 feet high. Between these points there is a gradual and fairly uniform eastward slope.

East of Mississippi River the upland is even better shown than on the west side, its remnants being larger, and many of the valleys narrower and more sharply outlined. The continued downward slope to the east is, however, less distinct, being complicated by various other factors, among which are the added elevations due to the Illinoian drift sheet and the exaggerated easterly slope due to the extraordinary thickness of the loess on the bluffs.

SMALL VALLEYS.

Inasmuch as the upland is everywhere covered with loess to a depth of 10 to 50 feet, the smaller and younger valleys are generally confined to that material. The characteristic cross section of those which are being cut under present conditions shows convex lateral slopes, the steepness increasing as the axis is approached. The steepness of the lateral slopes varies, of course, with the fall and cutting power of the stream and is greatest near the bluffs, but upward convexity of valley sides is the rule in these young valleys, whether gentle or steep.

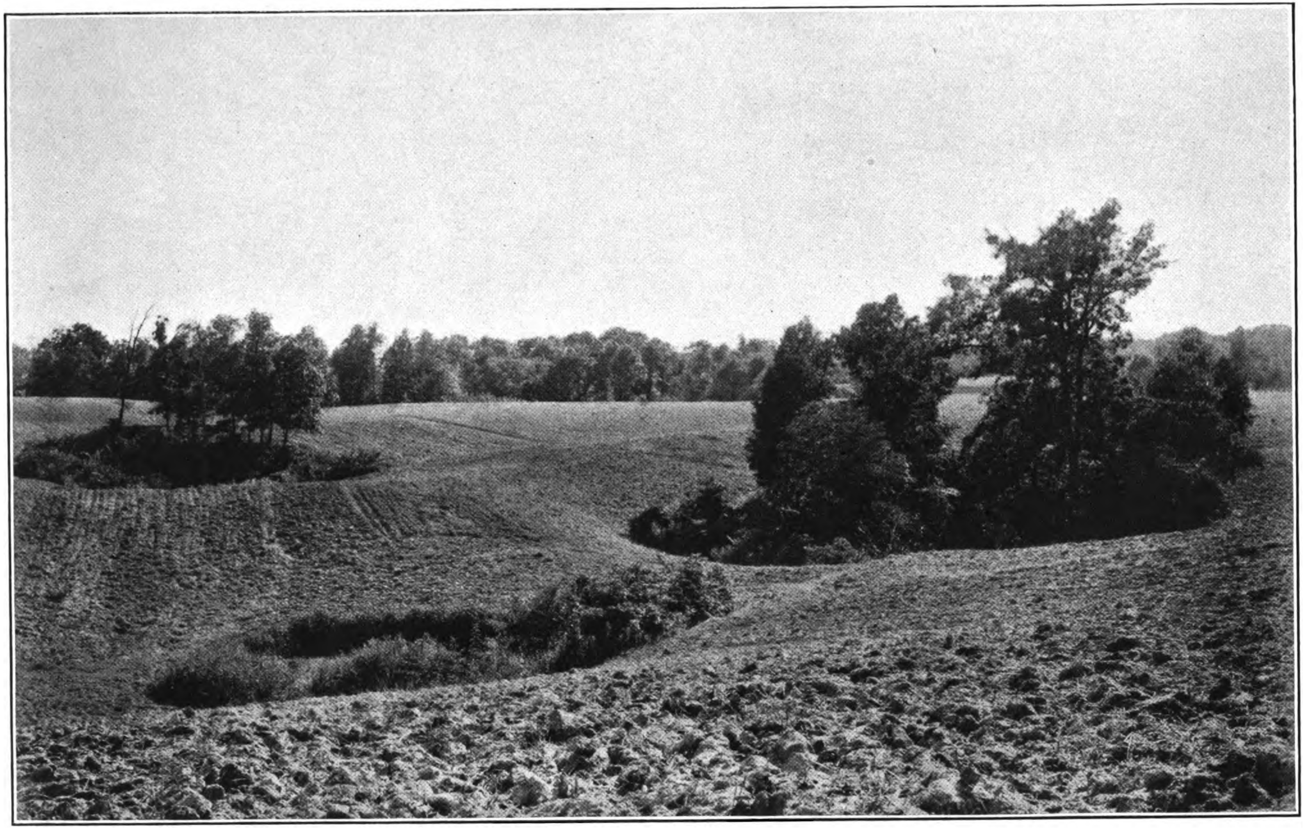
The characteristic cross section of young valleys in the loess may be modified where gullying or excessive surface wash affects the sides. Under such conditions, which may be incident to cultivation, the excessive waste from the sides has accumulated below, giving compound curves to the otherwise upwardly convex side slopes. Valleys of somewhat greater size and age, such as those of the several branches of the River Des Peres, have lateral slopes of compound curves, being steeper at intermediate heights than near the streams. Still larger valleys, such as those of the lower Des Peres, have distinct flood plains.

ROCK TERRACES.

Here and there rock terraces border the larger valleys. The most conspicuous is at the foot of the east bluff of the Missouri, north of Creve Cœur Lake, opposite St. Charles. Here, for several miles north and south of Bonfils station, is a fine terrace about 40 feet above the flood plain. A quarry opened near its outer edge shows that it consists of St. Louis limestone and not of alluvium, as might be inferred from its position. The steep backward (easterly) slope from its outer edge toward the main bluff is due entirely to the thickness of the loess, which has here accumulated on the outer edge of the terrace, as it has elsewhere on the margin of the upland; that is, at the summit of the main bluff. Minor rock terraces appear on the east side of the Mississippi and on the south side of the Meramec west of Valley Park.

RELATION OF TOPOGRAPHY AND UNDERLYING ROCKS.

The topography of this region reflects to a striking degree the character of the underlying rock In places where that rock is limestone there is an extraordinary development of sink holes and subsurface drainage. These sink holes are numerous near the southern margin of the quadrangle, near the Mississippi bluff, as is well shown on the map (Pl. I, in pocket). (See also Pl. II, opposite.) Large areas in the city of St. Louis furnish abundant and striking examples, and in parts of the city similar holes have been filled. Sink holes do not occur where the limestone is covered by even a few feet of shale, and are consequently absent from that part of the area where the



SINK HOLES SOUTH OF STOLLE, ILL.

(See page 10.)

Pennsylvanian rocks are present. (See geologic map, Pl. I.) On these rocks, which consist largely of shale, the larger valleys (cut in the bedrock and not confined to the loess) are characterized by broad and gentle curves.

Where the topography is not completely dominated by a thick loess cover, with its characteristic valleys, it is frequently possible to judge of the underlying formation with considerable accuracy by the surface forms alone. This fact is strikingly illustrated on almost all sides of the great fire-clay district of Cheltenham, south of Forest Park, St. Louis. This district is essentially coextensive with the "Coal Measures," on which no sink holes exist. It is surrounded by a limestone area that is in most parts closely perforated with such holes, which are crowded close up to the margin of the Pennsylvanian area.

MISSISSIPPI FLOOD PLAIN.

Across the center of the quadrangle stretches the Mississippi flood plain, having a width varying from 3 to 10 miles. The surface of this plain declines slightly to the south with the grade of the river, whose fall is about 6 inches to the mile from the mouth of the Missouri to that of the Ohio. At the Eads Bridge, St. Louis, zero of the gage is taken at 380.23 feet above mean sea level. At Jefferson Barracks, which is 10.7 miles to the south, zero is 377.94 feet above sea level. The corresponding zero at the Chain of Rocks, 10.2 miles north of the Eads Bridge, is 384.31 feet. The fall of the river near St. Louis is therefore about 3⅔ feet to the mile, and the corresponding southward slope of the flood plain is about twice as great.

The greater part of the flood plain has an elevation between 400 and 420 feet, the latter height being exceeded only in the immediate vicinity of the bluffs and on a few isolated mounds. The surface of the flood plain, though containing many flat tracts, is far from being uniformly flat. A detailed map, giving contours at 5-foot intervals, shows that the plain is in a large way ribbed or fluted with broad, low ridges and intervening slashes. There may be as many as ten such alternations of level within a mile, though the average width of ridges and swales is a considerable fraction of a mile. The prevailing though by no means uniform trend of these features is roughly parallel to the river at its nearest point or to a former channel now represented by an oxbow lake. Many of the swales or slashes are so low as to be swampy, and on the intervening higher grounds are fertile farms, which would be very valuable except for the liability to overflow. Near the Illinois bluff the level of the plain is higher, and there is a perceptible slope away from the bluff. Farms on this portion of the plain have extreme fertility.

Floods in historic times have not been known to rise higher than 421.63 feet above mean sea level. As this height has been observed but once (1844) and the next highest flood (1903) fell fully 3 feet short of it, the 420-foot contour line may, for practical purposes, be taken as the approximate limit of floods. This leaves, on the eastern margin of the flood plain, north of Edgemont, a strip not subject to overflow. The width of this strip, whose level has been raised by outwash of loess from the bluffs, is irregular, but averages a mile.

About 7 miles northeast of the Eads Bridge is a group of mounds, in part natural, though the highest of all, known as Monks or Cahokia Mound, is in part artificial. These elevations vary in height from a few feet to more than 100 feet and in diameter from a few rods to nearly 1,000 feet. They are composed of alluvium, and are in the main remnants of a former valley filling. Wherever observed, the material is fine sand or loam, similar to that which covers the flood plain. It may be in part a redeposited loess. To a height of 35 feet above its base the material of Monks Mound shows assortment and stratification, which is evidently natural. Above that height it affords no structural evidence bearing on the question whether it is of natural or artificial origin; but the form plainly indicates the work of man, and not of geologic processes. It is highly probable that the mound in its natural condition was much lower and broader than at present, and was of rounded, almost drumloidal form, similar to the smaller ones of the group which now surround it. By cutting down its margin to the level of the surrounding plain its builders obtained material to raise the mound to perhaps two or three times its former height without making excavations beneath the level of the plain and without carrying material from the bluffs, 2½ miles distant. There is no evidence that material was obtained by either of these latter means.

Of the surrounding group of mounds those of conspicuous height and abrupt slopes are doubtless of the same composite origin as Monks Mound. The smaller ones, of gentle slope and oval form, no doubt represent the original condition of all.

DRAINAGE.

The drainage of the entire region flows, for the most part, through short streams directly into the Mississippi. A portion of the territory, however, drains northwestward to the Missouri, whose course is here northeastward toward Bellefontaine and Alton. The divide between these two systems is not a striking topographic feature and only at isolated points does it rise above the general upland level. Such isolated eminences are the low and poorly defined swell on which Stratmann stands and a similar rise several miles farther north.

An area equal to that drained by the Missouri lies in the basin of Meramec River, which flows southeastward, joining the Mississippi about 15 miles south of St. Louis. The divide between the Meramec and Missouri systems is marked by the high ground near Altheim.

The small streams that enter the Mississippi from the east are obliged to traverse the broad flood plain, and in these portions of their courses may have vague and ill-defined valleys. From the loess-covered bluffs and uplands they bring down much silt, which is spread out at the foot of the bluff, often clogging the streams and causing their courses to change. Schoenberger Creek, emerging from the bluff at French Village, is said to flow either north or south in the same channel, according to the stage of the water in the basin of Cahokia Creek, on the north, and of Prairie du Pont Creek, on the south.[a]

DESCRIPTIVE GEOLOGY.

STRATIGRAPHY.

GENERAL SECTION.

The indurated strata exposed in this area are all of Carboniferous age. Natural exposures of these beds are found only in the steeper bluffs and here and there in a gully. Mesozoic rocks are absent. The Tertiary is represented by a few small patches of gravel believed to be of Lafayette age. These indurated rocks and gravel are almost everywhere covered by Pleistocene deposits. East of Mississippi River these younger deposits include bowlder clay of the Illinoian glacial epoch. Probably bowlder clay of both Illinoian and Kansan age is present in small quantities on the west side of the river. Whatever till may exist is covered by loess. Along Mississippi River the Mississippian strata are overlain by a thick deposit of alluvium.

The geologic column in the area mapped is as follows:

Formations in the St. Louis quadrangle.

- Quaternary.
  - Recent.
    - Alluvium.
    - Terrace deposits.
  - Pleistocene.
    - Wisconsin.
    - Loess.
    - Illinoian drift.
    - Kansan drift.
- Unconformity.
- Tertiary.
  - Lafayette gravel.
- Unconformity.
- Carboniferous.
  - Pennsylvanian ("Coal Measures").
  - Mississippian.
    - Chester group (?).
      - Birdsville formation (?).

---

[a] Helm, E. G., Jour. Assoc. Eng. Soc., vol. 35, 1905, p. 96.

- Carboniferous—Continued.
    - Mississippian—Continued.
        - Meramec group.
            - St. Louis limestone.
            - Spergen limestone.
            - Warsaw shale.
        - Osage group.
            - Keokuk limestone.
            - Burlington limestone.
        - Kinderhook formation.
            - Fern Glen limestone member.
            - Bushberg sandstone member.
            - Glen Park limestone member.
- Devonian (?).
- Ordovician.
    - Richmond group.
        - Maquoketa shale.
        - Fernvale limestone.
    - Kimmswick limestone.
    - Plattin limestone (Black River, Lowville, and Stones River).
    - Joachim limestone.
    - St. Peter sandstone.
- Cambro-Ordovician.
    - Jefferson City limestone.
    - Roubidoux formation.
    - Gasconade formation.
    - Proctor limestone.
    - Potosi limestone.
- Cambrian.
    - Elvins formation.
    - Bonne Terre limestone.
    - La Motte sandstone.

None of the rocks beneath the Osage group outcrop in this area. A few miles west of the area, however, and likewise a few miles to the south, there are outcrops of the Kinderhook formation, at the base of the Mississippian, and the upper strata of the Ordovician. The formations outcropping near but not within the area mapped are discussed briefly here because they are reached by deep wells in St. Louis.

DETAILED WELL SECTIONS.

Among the wells more than 2,000 feet deep in and near St. Louis there are three or more in the drilling of which the strata were observed with care. These records furnish most of what is known directly of the deeper rocks beneath the St. Louis quadrangle. The sections of these wells are therefore given and will be found useful for frequent reference in reading what follows.

WELL NEAR MONKS MOUND.

A well was drilled for oil about the year 1903 on a small mound about 1,000 feet southwest of Monks Mound and about 7 miles northeast of the Eads Bridge. The altitude at the mouth of the well is approximately 435 feet. At least 100 samples were carefully taken by S. L. Shellenberger, of East St. Louis, and their depth recorded on labels. The samples were placed in bottles and presented to the St. Louis Academy of Science. The following log is made up from a study of these samples, its interpretation being in part the work of E. O. Ulrich. The identification of one or two formations and the exact boundaries of several others are in doubt, as will appear from the method of grouping adopted.

Log of well near Monks Mound, Illinois.

	Thickness.	Depth.
Quaternary:		
Alluvium, 150 feet.	*Feet.*	*Feet,*
29. Soil, sand, and gravel	150	150
Carboniferous:		
Pennsylvanian ("Coal Measures"), 75 feet.		
28. Dark-blue clay, very slightly calcareous	55	205
27. Gray to light-blue noncalcareous shale, in places laminated; a little limestone near top	20	225
Mississippian.		
Chester group (?) (probably Birdsville formation), 90 feet.		
26. Gray limestone, the lower portion of which is arenaceous or possibly cherty	10	235
25. Very fine white to gray sandstone, very slightly calcareous	65	300
24. Light-colored limestone	5	305
23. Very fine light-colored sandstone	10	315
St. Louis and Spergen limestones, 403 feet.		
22. Limestone, characteristically dense, much of it light colored, at some places cherty or ferruginous	175	490
21. Limestone, not so dense as No. 8; crinoid stems above 650 feet; much of it cherty and ferruginous; abounding in white chert in last 10 feet. (In part Spergen)	190	680
20. Limestone of light color and containing some clay. (No doubt Spergen)	38	718
Warsaw shale, 62 feet.		
19. Blue calcareous clay	62	780
Osage group (Keokuk and Burlington limestones), 235 feet.		
18. Limestone and (largely) white chert	185	965
17. Greenish-gray limestone, the basal portion of which abounds in greenish chert; some fragments of pink shale [a]	50	1,015
Kinderhook group (with possibly some Devonian at base), 80 feet.		
16. Pink calcareous shale (Fern Glen)	30	1,045
15. Limestone, white to green and red; crinoid stems (Fern Glen)	5	1,050
14. Light-green calcareous plastic clay	2	1,052
13. Light-colored dense limestone; a few sand grains in lower part	23	1,075
12. Gray and pink limestone; perhaps a 5-foot band of the latter near top; all contains large round sand grains. (Possibly Devonian in part or wholly)	20	1,095
Ordovician:		
Richmond group and Kimmswick limestone, 220 feet.		
11. Blue shale, calcareous except near base, where it is also harder and more gritty (Maquoketa)	40	1,135
10. Gray limestone	35	1,170
9. Brownish-pink gritty limestone with admixture of fragments like that above	25	1,195
8. Limestone, gray with subordinate pink in upper portion; light gray to white in lower portion	120	1,315
Plattin and Joachim limestones, 660 feet.		
7. White limestone; upper half very siliceous	20	1,335
6. Greenish-gray shale, noncalcareous	45	1,380
5. Dark or greenish-gray argillaceous limestone or very calcareous shale	110	1,490
4. Limestone, mainly white; pinkish near top and gray near base; some admixture of gray noncalcareous shale below the middle	210	1,700
3. Light-yellow limestone	75	1,775
2. Brownish-gray limestone	200	1,975
St. Peter sandstone, 125 feet.		
1. Pure sand, round grains	125	2,100

[a] It is possible that the basal portion of No. 17 should be classed with the Kinderhook; there is no sharp break.

WELL AT THE INSANE ASYLUM.

A well was drilled about forty years ago 5 miles west-southwest of the St. Louis post-office, at an elevation of 590 feet, to obtain a supply of good water for use at the insane asylum. C. W. Atkinson, who superintended the work, took samples every few feet and labeled them so as to show their depth. He also kept a log of the well which is on record in the office of the county clerk. The log given below was made up from a careful study of the samples by G. C. Broadhead,[a] at that time State geologist of Missouri. The original publication gives some additional details.

Log of well at the insane asylum, St. Louis.

[Prepared by G. C. Broadhead. The geologic names in brackets are the identifications of E. O. Ulrich.]

	Thickness.	Depth.
Quaternary:		
Bluff, 40 feet.	*Feet.*	*Feet.*
35. Clay	40	40
Carboniferous:		
Coal Measures [Pensylvanian], 80 feet.		
34. Clay and limestone	21	61
33. Coal, clay, and limestone	25	86
32. Shale, limestone, coal, and clay	34	120
Lower Carboniferous.		
[St. Louis, 318 feet.]		
31. Cherty limestone, blue, drab, and gray; upper part fine grained; lower part coarse	139	259
30. Shale	3	262
29. Drab cherty limestone; last 18 feet may belong with No. 8	176	438
[Spergen limestone, 62 feet.]		
28. Dark-drab limestone	62	500
[Warsaw shale, 36 feet.]		
27. Drab limestone and shales	36	536
[Osage group (including top of Kinderhook), 254 feet.]		
26. Hard blue cherty limestone	92	628
25. Limestone and chert	75	703
24. Sandstone; very fine grained	6	709
23. Chert and limestone	81	790
Chouteau [Kinderhook] group, 93 feet.		
22. Red limestone	10	800
21. Drab and gray limestone and chert	35	835
20. Dark limestone with some clay and chert	48	883
Lower Silurian [Ordovician; Devonian at top (?)]:		
Trenton, Black River, and Birdseye limestone [Devonian at top (?)], 421 feet.		
19. Clay [Maquoketa]	83	966
18. Blue shales and limestone [Fernvale]	56	1,022
17. Limestone with magnesian bands; cream colored and magnesian at base [Kimmswick in upper part]	194	1,216
Cherty limestone and salt water	9	1,225
Light and dark limestone	79	1,304
First limestone, 148 feet.		
16. Drab cherty limestone	49	1,353
15. Magnesian limestone [Joachim]	99	1,452
Saccharoidal sandstone [St. Peter], 133 feet.		
14. Sandstone of rounded grains; white and containing sulphur water above; somewhat brown in lower portion	133	1,585
[Cambro-Ordovician]:		
Second limestone [Jefferson City], 517 feet.		
13. Buff, brown, and drab cherty magnesian limestone	128	1,713
12. Buff and drab cherty magnesian limestone	389	2,102
Second sandstone [Roubidoux], 82 feet.		
11. Sandstone, hard and mostly pure; subordinate cherty limestone	82	2,184
Third limestone, 838 feet [probably includes Gasconade, Proctor, and Potosi limestone].		
10. Buff, drab, and gray cherty magnesian limestone; chert probably one-half the entire mass	487	2,671
9. Magnesian limestone with some sand; no chert	172	2,843
8. Sandstone; a little limestone in upper part	37	2,880
7. Magnesian limestone	142	3,022

---

[a] Trans. St. Louis Acad. Sci., vol. 3, 1873, p. 216. It is understood that this study was made some years after the well was drilled and the samples stored. Whatever interference with or mixing of the samples may have occurred in the meantime, Broadhead's log differs little from that which was filed by the superintentendent. Furthermore, on comparison of this log with the logs of the other deep wells it is seen to be consistent.

During the drilling of this well Prof. Hambach, of Washington University, St. Louis, took samples with great regularity and systematically kept a log from day to day which he platted on a large scale. Some years later this log passed into the hands of Charles A. Ashburner, of Pennsylvania, but it can not now be located. It is greatly to be regretted that this full and accurate information concerning one of the deepest wells in the world should have been lost.

Log of well at the insane asylum, St. Louis—Continued.

	Thickness.	Depth.
[Cambro-Ordovician]—Continued.		
Third sandstone, 98 feet [not Swallow's Third sandstone of the Osage River section.]	*Feet.*	*Feet.*
6. Sandstone	98	3,120
[Cambrian]:		
Fourth limestone, 384 feet [not Swallow's Fourth limestone of the Osage River section].		
5. Dark magnesian slate [Elvins formation]	13	3,133
4. Magnesian limestone with some sand in lower beds [Bonne Terre limestone]	371	3,504
Potsdam sandstone [La Motte] and Azoic, 299.5 feet.		
3. Sandstone; hard, thin bedded; dark olive gray	41	3,545
2. Sand and limestone	13	3,558
1. Brown and red sandstone; lower beds hard and red	245.5	3,803.5
Granite—pronounced such because "some of the grains are red quartz or feldspar"	40	3,843.5

BELCHER WELL.

The Belcher well, at Second and O'Fallon streets, St. Louis, half a mile north of the Eads Bridge, is famous for its mineral water. It was finished in 1854 and is 2,199 feet deep. The altitude at the surface is 420 feet. The log of the well was kept by Louis Holm and subsequently studied and prepared for publication by A. Litton, M. D.

Log of the Belcher well, St. Louis.[a]

[Prepared by A. Litton, M. D.]

	Thickness.	Depth.
Carboniferous, 630 feet.	*Feet.*	*Feet.*
Limestone with chert; a few inches of shale 30 feet below top	265	265
Cherty rock	12	277
Limestone	73	350
Shale	30	380
Limestone, with shale streak at 455 feet	115	495
Shale	10	505
Limestone (first saline taste to water at 610 feet)	125	630
Chemung (?), 95 feet.		
Red marl[b]	18	648
Shale	27	675
Red marl	50	725
Upper Silurian or Chemung (?), 37 feet.		
Shale[c]	37	762
Hudson River, Trenton, and Black River groups, 650 feet.		
Limestone	121	883
Shale	67	950
Bituminous marl	18	968
Shale	77	1,045
Limestone	138	1,183
Cherty rock	57	1,240
Limestone	130	1,370
Shale	15	1,385
Limestone	27	1,412
Magnesian limestone series, 787 feet.		
Shale	50	1,462
Limestone	38	1,500
White soft sandstone[d]	140	1,640
Sandstone with much iron[e]	185	1,825
Sandstone with clay	195	2,020
Sandstone with lime and clay	179	2,199

---

[a] Trans. St. Louis Acad. Sci., vol. 1, p. 80.

[b] Now classed as Fern Glen limestone, member of the Kinderhook formation.—N. M. F.

[c] Probably Maquoketa.—N. M. F.

[d] St. Peter sandstone.—E. O. U.

[e] The lower 559 feet, determined as sandstone by Litton, probably consists mainly of dolomitic limestone.—E. O. U.

ORDOVICIAN SYSTEM.

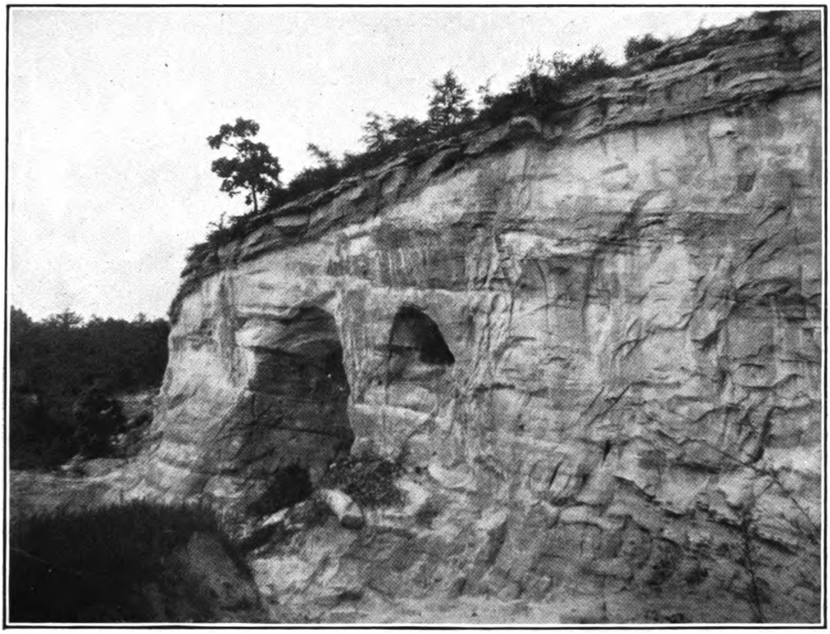
In this area the upper formations of the Ordovician system are significant chiefly as horizon markers in deep-well sections. The readily recognizable character of one of them has greatly facilitated the interpretation of well logs and thereby the determination of structural features. The treatment here of formations not exposed within the area mapped has therefore primary reference to their position in the column and to the prominent characteristics which make them easily recognizable.

ST. PETER SANDSTONE.

The St. Peter sandstone (known also as the "Saccharoidal" sandstone, "First" sandstone, "Crystal City" sandstone, "Pacific" sandstone, and "Cap au Gres" sandstone) is composed almost entirely of well-rounded grains of generally translucent quartz, medium to large in size and poorly cemented with silica. Partly because of the deficiency in cement and partly because of the roundness of the grains, the rock is very friable. It may be almost pure white or stained with iron oxide to various shades of yellow, pink, or even red. In places the iron stain occurs in irregular blotches or incipient concretions. The thickness of the formation at Pacific, 34 miles west of St. Louis, is at least 110 feet. (See Pl. III, *A*.) The well at the insane asylum, St. Louis, is believed to pass through 133 feet of this formation. The thickness, however, varies from 200 feet down to the vanishing point, the sandstone being unconformable both above and below.

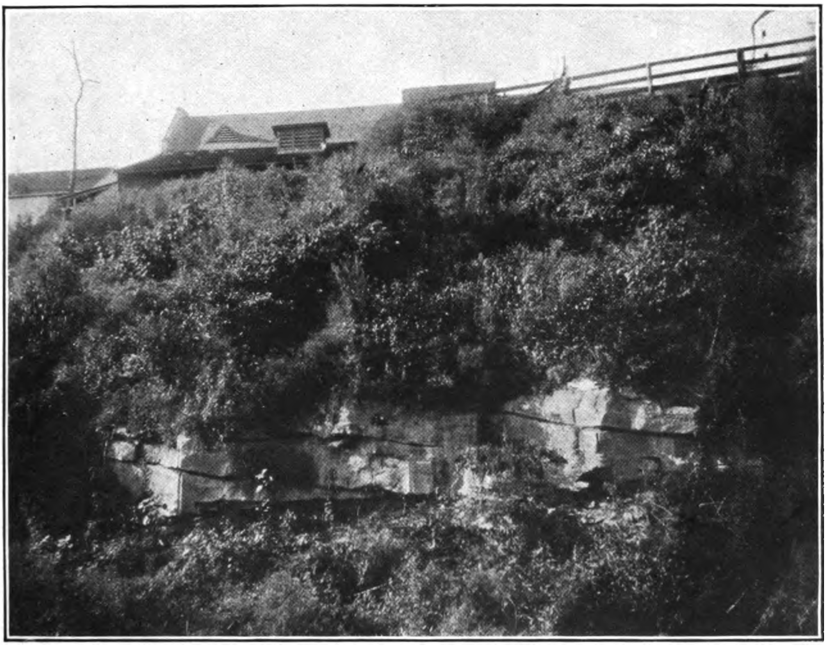
FORMATIONS ABOVE THE ST. PETER SANDSTONE.

Overlying the St. Peter sandstone, and like it not outcropping within the area mapped on Plate I, are 600 to 800 feet or more of limestones and shales which were not studied in detail. They represent the Plattin, Joachim, and Kimmswick (Ordovician) limestones, the Maquoketa shale (upper Ordovician), and possibly also some Devonian shale and limestone. The limestones may be seen in descending order in outcrops or railroad cuts in going from Fern Glen, 20 miles west of St. Louis, to Pacific Junction, 14 miles farther west. Both the limestones and the overlying shales are shown in railroad cuts south of Kimmswick, which is 20 miles south of St. Louis. These formations occupy in the Belcher well section the interval from 725 to 1,505 feet, in the asylum well from 883 to 1,452 feet, in the Monks Mound well from 1,095 to 1,975 feet.



A. ST. PETER SANDSTONE CAPPED BY LIMESTONE, PACIFIC, MO.

(See page 18.)



B. CROSS-BEDDING IN SPERGEN LIMESTONE, MERAMEC HIGHLANDS, MO.

(See pages 22–23.)

CARBONIFEROUS SYSTEM.

MISSISSIPPIAN SERIES.

KINDERHOOK FORMATION.

Like the Ordovician formations named above, the Kinderhook does not outcrop within the area mapped. Its prominence in the well logs, however, requires its description in some detail. It contains several distinct members, arranged from above downward as follows:

4. Greenish-gray cherty limestone (supposed base of Burlington, but may be in part Kinderhook).
3. Pink calcareous cherty shale and limestone, with locally a 4-foot massive gray to greenish limestone at base (Fern Glen limestone member).
2. Yellow friable sandstone (Bushberg sandstone member, local).
1. Gray limestone, in many places containing sand grains (Glen Park limestone member, local).

These members of the Kinderhook are well exposed at Glen Park, 23 miles south of St. Louis, where the section is as follows:

Section at Glen Park, Mo.[a]

	Ft.	in.
11. Cherty limestone (Burlington)	18	
10. Cherty greenish-gray limestone (Burlington) [may contain some Kinderhook near base]	7	
9. Red, more or less argillaceous, limestone and chert with greenish blotches (Fern Glen)	8	6
8. Unexposed, probably a softer red calcareous shale covered with talus (Fern Glen)	6	
7. Hard, somewhat crystalline yellow or gray limestone [undoubtedly a part of the Fern Glen]	4	
6. Yellow fine-grained sandstone, becoming brown on the weathered surface (Bushberg sandstone)	14	
5. Sandy shale		4
4. Limestone, coarse, light gray, oolitic, and fossiliferous (Glen Park limestone)	1	3
3. Dull yellow shales and shaly limestone (Maquoketa)	4	
2. Hard, dark-colored, brown or bluish fossiliferous limestone (Richmond) [Fernvale]	1	6
1. Kimmswick limestone (Trenton fossils)	55	

The upper Kinderhook is likewise typically exposed at Fern Glen, 20 miles west of St. Louis, and from this place the name Fern Glen limestone member is taken. The section at Fern Glen is as follows:

Section at Fern Glen, Mo.[b]

	Feet.
5. Cherty limestone (Burlington; may contain some Kinderhook near base)	(?)
4. Greenish calcareous shale, with chert bands and nodules, becoming reddish near base and grading into No. 3	14
3. Red calcareous, highly fossiliferous shales, with chert and some limestone	12
2. Pink to red cherty limestone	14
1. Buff to greenish limestone with crystalline crinoid stems	4

---

[a] Weller, Stuart, Kinderhook faunal studies: Trans. St. Louis Acad. Sci., vol. 16, 1906, pp. 435–438. The notes in brackets are supplied by the present writer.

[b] The measurements in this section are taken from Weller's unpublished notes.

Beds 1 to 4 in the above section constitute the Fern Glen limestone member of the Kinderhook formation.

The cherty limestone above the shale, between the Osage group and the Fern Glen limestone member, is physically continuous with the overlying Osage, from which it is with difficulty delimited because of the lack of a sharp break in the character of the fossils. The thickness of this limestone, therefore, which should be classed with the Kinderhook, is uncertain.

No. 3, in the general section of the Kinderhook (p. 19), is the Fern Glen limestone member and is found wherever this horizon is exposed or drilled through, in and near the area studied. Its striking characteristics are its pink or red color and its large proportion of shale. At Fern Glen (see p. 19) it grades from a pure massive limestone at the base to shale at the top. Its red color is most pronounced in the middle, and it is cherty throughout, with the exception of the massive limestone at its base. The appearance of the Fern Glen limestone member at Glen Park (Nos. 7 to 9 of the section at that place) is essentially the same, though limestone forms a somewhat greater proportion of the whole than at Fern Glen. Among the characteristic fossils of this member are *Zaphrentis* (several species), *Cyathaxonia* sp., *Evactinopora* sp., *Leptæna rhomboidalis*, *Rhipidomella* (small species), *Spirifer vernonensis*, *Spirifer imbrex*, *Athyris prouti*, and *Athyris lamellosa*.

OSAGE GROUP (BURLINGTON AND KEOKUK LIMESTONES).

Overlying the Fern Glen limestone member is from 200 to 250 feet of cherty limestone doubtless comprising both the Burlington and the Keokuk limestones. Because of the continuity of character throughout and the absence of a decided paleontologic break, all these beds are treated together here under the more comprehensive term Osage group.

The outcrops of this group within the area mapped are limited to the southwest corner of the quadrangle, in the valley of Meramec River. In this area only the upper 100 feet is exposed and all the fossils found are of Keokuk age.

The limestone is characteristically light colored and thin bedded, the thickness of the several beds being generally a fraction of a foot, but in extreme cases reaching several feet. The one conspicuous physical characteristic of these rocks is the great abundance of chert. Throughout their greater part chert constitutes approximately half of the mass. The chert is distributed in beds, irregular zones, and bands of concretions more or less separated into individual units, some elliptical and even spherical. The prevailing form is in beds of irregular thickness and wavy surfaces, so that on a casual view an exposure gives the impression of irregularly interbedded limestone and chert. The chert is commonly gray. Individual concretions may be beautifully banded. On weathering it becomes white, or superficially red, by oxidation of iron. Nodules are not uncommonly embedded in a red residual clay. On surfaces long exposed the chert is much broken into irregular or prismatic small blocks, or may have acquired a cavernous surface through solution.

Within the limestone beds recrystallization is common. The cleavage faces of the resulting crystals give to a newly broken surface a sparkling appearance. The great abundance of fragments of crinoid stems and other fossils suggested the old name "Encrinital limestone." These fossil fragments, themselves usually calcitized, unite their effect with that of the calcite crystals in the matrix to give to the rock a very coarse grain. This is a characteristic though not a universal feature of the entire formation. On some weathered surfaces the fossil fragments stand out with peculiar boldness.

Near the top the formation is locally shaly, a general section of the entire Osage in this quadrangle being as follows:

Section of Osage group in St. Louis quadrangle.

	Feet.
Fossiliferous dark-gray limestone and chert	10–15
Varying amounts of blue, yellow, and red shales intermixed with the limestone and chert	20–30
Light-colored, thin-bedded limestone and chert, sparingly fossiliferous	175–225

The characteristic fossils of the upper part of the great mass of cherty limestone are the crinoid stems mentioned above and large brachiopods, among which *Spirifer logani* is prominent. Near the top there are also *Archimedes* and other bryozoans, with an occasional trilobite. Fully 50 feet below the top of the formation there is locally a 2 or 3 foot bed of limestone, free from chert and carrying a fauna with some Spergen affinities. (See "Geologic history," p. 40.)

MERAMEC GROUP.

Warsaw shale.—Overlying the Osage group is the Warsaw shale, 75 feet thick, which is chiefly composed of shale, though containing subordinate limestone beds. Like the Osage rocks; it outcrops only in the southwest corner of the St. Louis quadrangle. On account of its weakness it is rarely exposed at the surface. In the basal zone of this formation, varying from 10 to 20 feet in thickness, the amount of limestone exceeds that of shale. As this limestone is cherty, like that below, and as its fossils are not very different from those of the Keokuk, there may be a question as to where it should be classed. It is in fact transitional, though placed for convenience with the overlying shale. The limestone is darker in color and dense, lacking the coarse grain of the typical encrinital beds below. The chert is generally of a dark-reddish color and is smaller in amount and more nodular in form than that in the Osage group.

The body of the formation is of soft shale, blue in great part but yellowish near the summit. This portion, however, also includes subordinate beds of limestone, one of which, about 4 feet thick and some 20 feet above the basal limestones, contains *Spirifer keokuk* in such abundance as to make the horizon easily recognizable. The stone of this bed is granular.

Both shale and limestone, especially the latter, are fossiliferous. The characteristic types are crinoid stems, brachiopods, and *Archimedes wortheni*, with other bryozoans.

Spergen limestone.—The top of the Warsaw is sharply marked by a contact of the shale with a thick-bedded granular limestone. With slight variations this limestone, the Spergen, continues upward for a thickness of at least 60 feet. (See Pl. III, *B*.)

Like the lower formations, the Spergen is found chiefly in the southwest corner of the St. Louis quadrangle, where it caps the uplands, outcropping in many ledges on the upper slopes of the Meramec Valley where the loess has been eroded away. It also appears at the surface in several other valleys, notably in the Illinois bluff of the Mississippi on the southern margin of the area mapped and in the bottom of one or two quarries in the bluff at St. Louis.

A well-exposed section of the Spergen at the quarry just east of the Meramec Highlands station on the St. Louis and San Francisco Railroad is as follows, the order here given being from top to bottom:

Section of Spergen limestone at quarry near Meramec Highlands, Mo.[a]

	Feet.
Massive granular gray limestone with few fossils	10
Shaly beds with argillaceous, fine-grained limestone	3
Limestone with characteristic Spergen fossils	5
Limestone, somewhat shaly and magnesian in places	8
Limestone with typical Spergen fauna at top	5
Dense limestone, somewhat magnesian—*Rhynchonella* zone	5
Yellow shaly bed	9
Limestone	5
Fossiliferous limestone; many Bryozoa, etc	3
Limestone	10
Yellow to gray granular limestone	3
	66

The Spergen is physically distinguished from the Warsaw below by the abrupt transition from shale to limestone, though very subordinate shale beds occur also in the upper formation. Locally it is distinguished with almost equal clearness from the overlying St. Louis limestone by its lack of chert, which within this area is invariably present in the St. Louis and is in many places abundant. Elsewhere the line separating the Spergen from the succeeding formation is less definite.

---

[a] From field notes by Stuart Weller.

The most characteristic phase of the Spergen is a thick-bedded, in places cross-bedded (Pl. III, *B*), pure granular fossiliferous gray limestone carrying the Spergen Hill (Indiana) fauna and having a striking resemblance in physical character to the well-known "Bedford" (Indiana) limestone of commerce. This phase prevails near the middle. Locally it is a closely packed mass of fossil shell fragments or a conglomerate of unbroken *Rhynchonella* shells. Such a zone may be found some 30 feet from the top. In some places it is 6 inches or more in thickness and composed entirely of *Rhynchonella* sp.; elsewhere the fossils are less closely packed throughout a thickness of several feet.

At other horizons the coarse grain of the "Bedford" type gives way to fine grain, exemplified by the topmost ledge of 10 feet, which is very massive, dense, and gray, and is affected by stylolitic structure. In general, this bed resembles the overlying St. Louis except for its entire lack of chert. Immediately beneath this topmost ledge is a zone of about 5 feet in which shales occur locally but grade laterally into argillaceous or fine-grained limestone. Similar shale bands, some of them persisting for a mile or more, occur below the *Rhynchonella* zone. The base of the formation, like its summit, contains dense beds having a magnesian appearance.

One fossil form characteristic of the Spergen is *Rhipidomella dubia.* Long-winged and finely plicated spirifers are also abundant near the base of the formation, and bryozoans likewise abound, especially in the lower half. In general the Spergen fauna is closely similar to that of the same formation in Indiana.

St. Louis limestone.—The St. Louis limestone, which overlies the Spergen, forms the bedrock of most of the area not underlain by Pennsylvanian rocks. Its thickness averages about 325 feet. This formation is almost wholly limestone, but contains local thin streaks of shale. The thickness of its beds varies from a few inches to many feet, and in some of the thicker layers cross-bedding is observed. Here and there a bed is also finely ripple marked. The formation as a whole may be described as at least slightly magnesian. The proportion of magnesium carbonate is usually low, but in a few beds it runs as high as 30 per cent.

The most obvious characteristic of the St. Louis limestone consists in its numerous beds which have the close texture and density of lithographic stone. Such rocks break with an almost glassy fracture and conchoidal form. This characteristic is most common in the thinner beds. As it is a striking feature and is not found in any other rocks of the vicinity, it offers a convenient and fairly trustworthy means of identifying the St. Louis limestone. It is rarely seen in the lowest third of the formation, but otherwise no rules can be given for its distribution.

Chert is abundant in the St. Louis limestone. It occurs at all levels, though many thick beds are at least locally free from it. In color it varies from gray to black and is in places banded like agate. Throughout the formation chert is most frequently seen in the form of nodules, but there are variations from isolated spherical nodules through bands of elliptical forms to beds of pure chert with more or less wavy surfaces. In places, indeed, the limestone assumes nodular forms within a chert matrix.

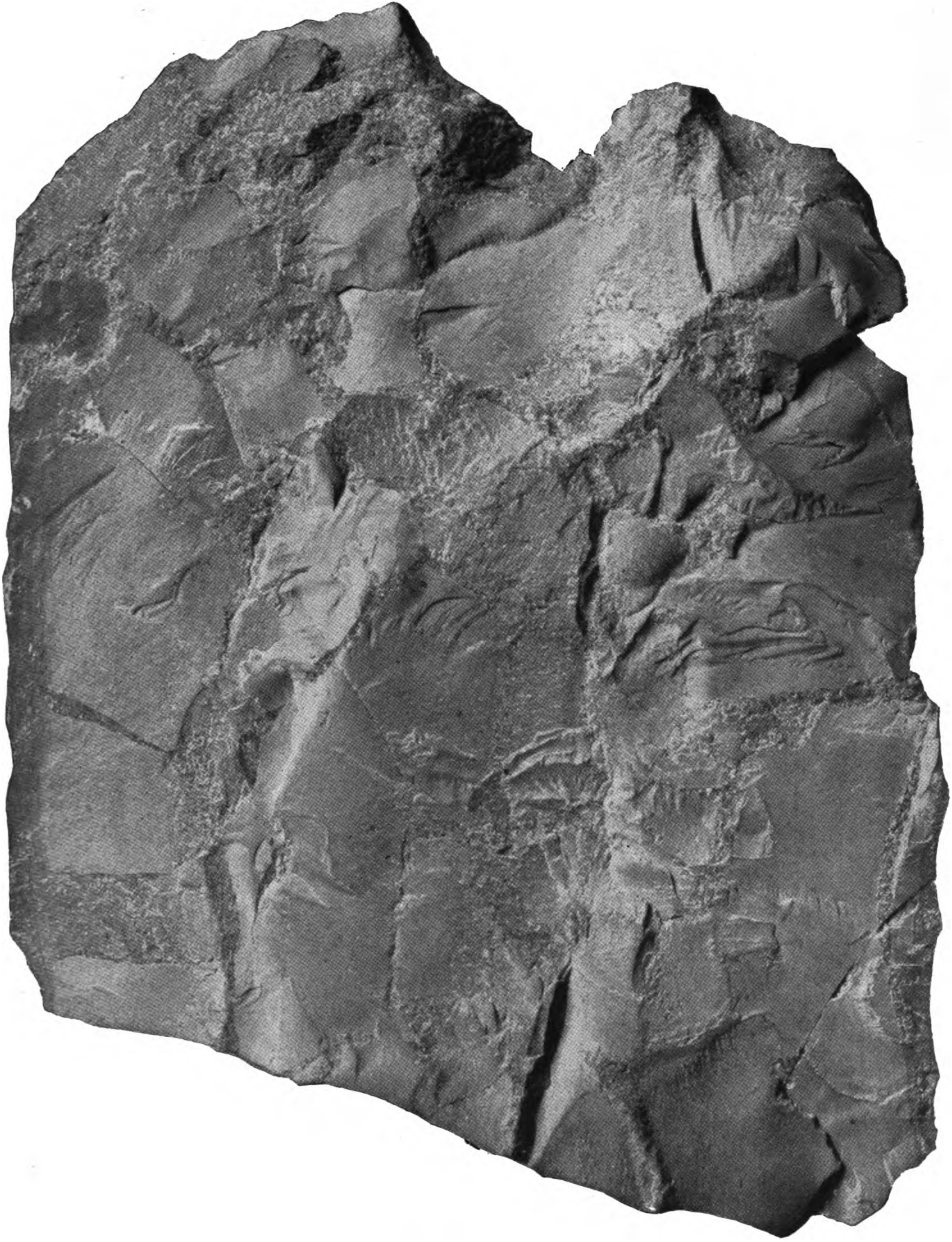
Here and there a bed is brecciated or incloses a brecciated zone between an upper and a lower portion which contain no suggestion of deformation. In some of such beds angular fragments of chert are embedded in a matrix of limestone; in others a band of chert shows a slight faulting not revealed by the limestone matrix. More commonly the angular fragments are of the dense lithographic type and the matrix is of coarse granular limestone. (See Pl. IV, opposite.) One such zone, exposed in Eyerman's quarry on Grand avenue, near the center of St. Louis, lies between two massive beds, each about 4 feet thick, almost without joints, bounded by plane surfaces and showing no evidence whatever of deformation. This zone is approximately 50 feet above the base of the St. Louis.

A further peculiarity of the St. Louis consists in its local beds of nodular limestone, in which spherical concretions of limestone are embedded in a matrix of the same material. The concretions, which have a diameter of 1 to 2 inches, are dense and hard and many of them are concentrically marked. The matrix is apparently less pure, coarser in texture, and in places shaly. Here and there such beds contain or adjoin thin bands of green shale or clay and in many beds of this character the limestone nodules, though not formed within the clay, protrude prominently from the surface of the limestone and indent the clay. Elsewhere interbedded limestones and clays both contain such concretions. These nodular limestones characterize two horizons, the higher being not more than 25 feet from the summit of the formation and the other about 100 feet lower. Both are shown in the quarries on North Broadway, near the Merchants Bridge.

The St. Louis is sparingly fossiliferous, the characteristic forms being *Lithostrotion canadense*, *Cystodictya lineata sancti-ludovici*, *Dichotrypa intermedia*, *Dichotrypa elegans*, *Derbya kaskaskiensis*, *Productus marginicinctus*, and *Spirifer littoni*.

CHESTER GROUP (?).

In the section of the Monks Mound well the rocks for 90 feet above the St. Louis limestone are provisionally classed as Chester,



BRECCIATED ST. LOUIS LIMESTONE.

The angular fragments are of the dense, fine-grained variety; the matrix is coarsely granular. (See page 24.)

75 feet of this being a fine white or gray sandstone, and the remaining 15 feet a gray limestone, a part of which is either arenaceous or cherty. A like thickness of water-bearing sandstone overlies the St. Louis limestone in wells at Belleville.

Rocks of Chester age do not outcrop within this area. Where the westward overlapping base of the Pennsylvanian rocks is exposed it rests unconformably on the St. Louis limestone, the Chester (?) noted in the Monks Mound well apparently wedging out before reaching the west side of the Mississippi.

PENNSYLVANIAN SERIES ("COAL MEASURES").

GENERAL CHARACTER.

The Pennsylvanian in the western part of this area rests unconformably on the St. Louis; elsewhere on the rocks that are here provisionally regarded as Chester. It consists of shale and clays, limestone, sandstone, and coal, named in the order of abundance. Most of the beds are believed to be of slight lateral extent, and sections having the same vertical range differ greatly in detail. West of the Mississippi the entire thickness slightly exceeds 100 feet. East of the river the thickness is more than 400 feet. The correlation of beds on opposite sides of the river is uncertain.

Within and near the city of St. Louis many shafts of fire-clay mines traverse the entire thickness of the Pennsylvanian series. A much generalized section at that place is as follows:

Section of Pennsylvanian series in the Cheltenham district, St. Louis.

		Feet.
12.	Weathered limestone ("tumble rock")	0 – 4
11.	Pipe clay, etc., maximum	15
10.	Coal (local)	0 – 4
9.	Limestone or "very hard blue rock"	3 –15
8.	Red and blue clays "keel," pipe clay, etc	13 –36
7.	Coal (very local)	0 – 1½
6.	"Roof" of fire clay—dark shaly sandstone or arenaceous shale with some plant remains	1 – 7
5.	"Clod"—an impure clay liable to fall in mining (local)	0 – ⅔
4.	Coal streak (very local)	0 – ¼
3.	Fire clay, Cheltenham bed	2½–12
2.	Light-colored sandstone with pyritic crystals.	
1.	Limestone containing red chert.	

As illustrations, the actual sections of two shafts are given below:

Section at Jamieson-French mine, 1½ miles south of Clayton, Mo.

	Feet.
Loess and soil	15
Red clay	10
"Gravel"	1
Limestone fragments in clay	3

	Ft.	in.
Gray pipe clay	15	
Very hard limestone	6	
Red shale	10	
Soft black shale	3	
Coal		8
Black sandy shale	1	6
Fire clay, Cheltenham bed; good clay taken out	8	6
Depth to floor	73	8

Beneath the good fire clay in this mine is several feet of green or iron-stained clay that is not mined. This is underlain by a pyritiferous sandstone of unknown thickness, probably at least 6 feet. At an outcrop half a mile to the south this sandstone is underlain by limestone containing large red cherts.

Section at Krümmel & Büchner mine, Columbia avenue and Woods street, St. Louis.

	Ft.	in.
Soil, loess, etc	38	
Limestone	4	
Coal	2	6
Very hard "blue rock"	8	
Clay, not refractory	10	
Blue shale and "keel"	15	
Dark shaly sandstone forming roof of mine	2	6
Fire clay, Cheltenham bed	7	
Light pyritiferous sand floor.		
Depth to floor	87	

Northwest of St. Louis, near Creve Cœur Lake, shafts and borings show the general section of the Pennsylvanian to be about as follows:

Section of Pennsylvanian rocks near Pattonville, Mo.

	Feet.
12. Red shale	20
11. Limestones and shales	15
10. Sandstone, massive and ferruginous	20
9. Shales, blue and brown	10–15
8. Thin-bedded limestone, locally interbedded with shale	10–18
7. Red and blue shales with locally a thin coal streak near middle	55
6. Micaceous shaly sandstone	5
5. Coal	1½
4. Black shale	½
3. Fire clay	12–15
2. Sandstone with ferruginous nodules (a few feet).	
1. Limestone.	

It is instructive to compare with these sections the typical section of Swallow's Lower Coal Series, taken in the western part of the State.

Section of the Lower Coal Series (Swallow).[a]

[Numbers at the left are from the original publication.]

		Feet.
60.	Soft brown, heavy bedded, irregularly stratified micaceous sandstone, often passing toward the base into a more compact gray variety	75
61.	Sandy shale (local)	3
62.	Coal	1
63.	Bituminous and sandy shale (local)	4
64.	Coal (thinner in St. Louis County)	6
65.	Argillaceous and sandy shale	1
66.	Fine, compact, hard blue and gray hydraulic limestone, frequently interstratified with clay and variegated with blue and gray spots; fossils abundant	8
67.	Bituminous and blue shales	6
68.	Coal	1½
69.	Dark shale and fire clay	7
70.	Coal	½
71.	Bituminous or blue shales	7
72.	Coal	1
73.	Bituminous shale	4
74.	Coal	3
75.	Shale and fire clay (believed to include the Cheltenham bed)	23

East of the Mississippi the character of the Pennsylvanian is clearly shown in the wells and mine shafts in and near Belleville. Two wells on the east side of the river showed the following sections:

Log of well at the vinegar factory, Belleville, Ill.

	Thickness.	Depth.
	Feet.	*Feet.*
Loess and yellow clay (at least the lower half probably being shale)	82	82
Hard limestone [b]	25	107
Gray shale with coal blossom near the middle	10	117
Limestone	15	132
Gray shale, as above	8	140
Limestone	15	155
Shale	2	157
Coal (Belleville bed)	6	163
Shale	9	172
Limestone	15	187
Light-colored shale	10	197
Coal blossom	......	......
Limestone	25	222
Light-colored shale	5	227
Limestone	20	247
Gray shale	15	262
Limestone	10	272
Soft yellowish sandstone; angular grains	35	307
Light-colored shale	25	332
Red or brown shale	15	347
Gritty limestone	15	362
Light-colored shale	15	377
Darker fossiliferous shale	30	407
Light-colored shale	28	435
Red or brown shale	15	450
Sandstone, water bearing	75	525
Hard limestone (probably St. Louis). Stopped at	90	615

---

[a] Geol. Survey Missouri, 1855, p. 86.

[b] It is quite probable that much of the "limestone" here reported is in reality interbedded limestone and shale.

Log of well drilled by the Illinois Hydraulic Press Brick Company near Collinsville, Ill.

	Thickness.		Depth.	
	Ft.	*in.*	*Ft.*	*in.*
30. Surface clay	40		40	
29. Clay shale	47		87	
28. Soft shale or fire clay, containing limestone	6		93	
27. Sandy shale	14		107	
26. Yellow shale	1		108	
25. Soft shale or fire clay	2		110	
24. Limestone	7		117	
23. Clay shale	6		123	
22. Limestone, sandstone, and shale	17		140	
21. Limestone with black shale partings	14		154	
20. Limestone	3		157	
19. Clay shale		3	157	3
18. Coal	6	8	163	11
17. Soft clay shale or fire clay	5	1	169	
16. Coal		8	169	8
15. Soft shale or fire clay	10	4	180	
14. Limestone	3	6	183	6
13. Clay shale	25	6	209	
12. Red shale	4		213	
11. Clay shale	52		265	
10. Limestone	1		266	
9. Black "slate"	2		268	
8. Coal	2	6	270	6
7. Fire clay	8	6	279	
6. Sandy shale	10		289	
5. Sandstone	17		306	
4. Limestone and fire clay	2		308	
3. Fire clay	3	4	311	4
2. Sandstone	1	8	313	
1. Clay shale	2		315	

CHELTENHAM FIRE CLAY.

Of the beds named in the above sections, a few are relatively persistent and may be traced with some certainty over considerable areas. Foremost among these is the bed of fire clay known as the Cheltenham. The equivalent of this bed on the east side of the Mississippi is not known, but on the Missouri side it underlies the western half of St. Louis and occurs also in the vicinity of Creve Cœur Lake and on the west bank of the Mississippi north of Baden, on the northern edge of the area mapped. Probably it underlies large areas between the places named, though its character there is uncertain. It is near the base of the series, the only intervening beds known being a thin pyritiferous or ferruginous sandstone and a limestone (probably thin) containing red cherts. The thickness of the fire clay ranges from 2½ to 12 feet. Almost everywhere it is overlain by 2 to 8 feet of shaly sandstone, generally micaceous. There are local coal blossoms near the contact of sandstone and fire clay.

SANDSTONES.

The ferruginous or pyritiferous sandstone beneath the Cheltenham fire clay occupies the same position with reference to the Mississippian limestone and the coal measures as that of the Chester group. This position may suggest their identity, but considering the overlapping character of both the Chester and the Pennsylvanian coal measures in a northwesterly direction, the late Mississippian age of this ferruginous sandstone seems highly improbable. In the absence of fossil evidence it has seemed preferable to regard this sandstone as the initial deposit of the Pennsylvanian overlap.

From 100 to 120 feet above the base of the Pennsylvanian on the Missouri side of the river is a sandstone which is somewhat continuous, ranging in thickness from a few feet up to 200 feet. The stone is characteristically yellow or brown, micaceous, rather soft, and in places coarse-grained, also cross-bedded. Swallow, who divided the coal measures of Missouri into three parts,[a] assigned to this micaceous sandstone the topmost place in his Lower Coal Series. (See section, p. 27.) Within the St. Louis area it is not known to be fossiliferous, but elsewhere, according to Swallow, its lower beds abound in Calamites, Sigillaria, and Lepidodendra. This sandstone is not present in the immediate vicinity of St. Louis, having doubtless been eroded. It is, however, found at Ramona Park and Jennings Heights, a few miles to the north, and at various other places along the northern boundary of the area, where it has a thickness of approximately 20 feet.

The equivalent of this sandstone on the Illinois side is not determined. A similar stratum is shown in the Belleville section, 143 feet above the supposed base of the Pennsylvanian, but the section below it does not resemble that of the lower Pennsylvanian on the Missouri side, and the two sections may or may not be equivalent.

COAL.

Two beds of coal west of the Mississippi are locally thick enough to be mined. These are Nos. 10 and 7 in the Cheltenham section (p. 25). The former is no doubt the same as No. 64 in Swallow's section (p. 27). The limestone underlying the coal, though locally (as in Swallow's section) separated from it by a thin bed of shale, is widely developed and serves to mark the horizon of the coal.

The lower bed (No. 7 in the Cheltenham section) is even thinner and more local than the upper bed. Bed No. 4 in the vicinity of St. Louis is generally a mere streak. Reference to Swallow's section will show that farther west the coal beds not far above the basal fire clay are not only thicker but more numerous.

East of the Mississippi the lowest coal of which there is any mention is No. 8 in the section near Collinsville (p. 28). This is probably from 150 to 200 feet above the base of the Pennsylvanian. The principal (Belleville) bed is a little more than 100 feet higher. The thickness of the lower and barren beds on the east side of the river is no doubt greater than on the west, but there is no evidence from this area that the Illinois coal beds correspond to those in Missouri.

---

[a] Geol. Survey Missouri, 1855.

The Belleville bed was in the early Illinois reports termed No. 1 C (later No. 6) and its recognition over a wide area was assumed. Within 50 feet or more below it two other continuous beds known as 1 B and 1 A (Alton bed) were assumed to exist. It is not probable that these correspond to those mentioned as Nos. 16 and 8 in the section near Collinsville. In the present state of knowledge of the coals of this region all such long-distance correlations are of questionable value.

TERTIARY SYSTEM.

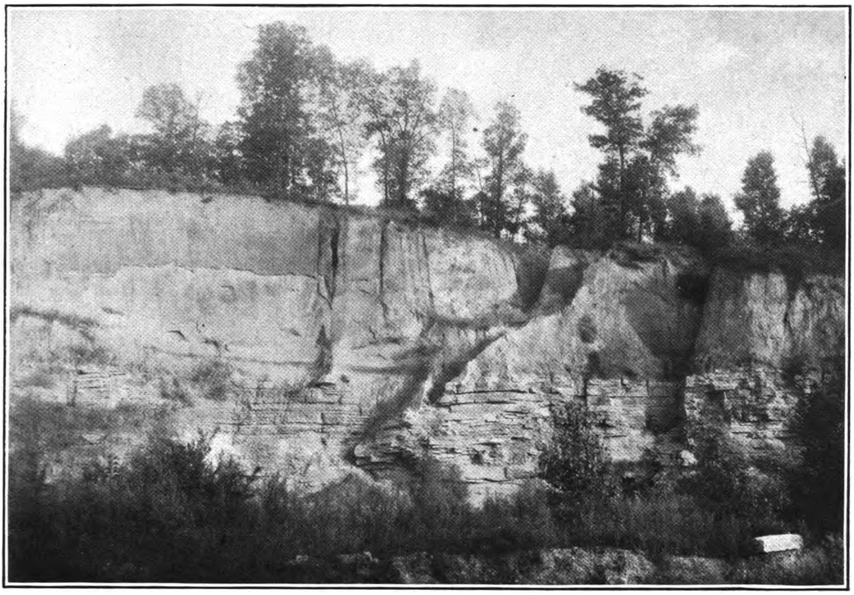
LAFAYETTE GRAVEL.

Composition.—At various places west of St. Louis on the higher parts of the upland are deposits of gravel whose character corresponds in general to that of the recognized Lafayette gravel of the Gulf and Atlantic Coastal Plain. The patches of gravel here preserved are believed to represent the same formation.[a] (See Pl. V, *B*.) The material of the gravel is largely chert, but it contains also pebbles of vein quartz, quartzite, and jasper. Some of the quartzite pebbles are of a purplish color and closely resemble the Baraboo quartzite of Wisconsin and the Sioux quartzite of Iowa and South Dakota. Many of the jasper pebbles strongly suggest the jaspilites of the Lake Superior region. The constituent stones of this gravel are characteristically rounded, the cherts being most angular, but even these being probably as much rounded as their brittleness will allow. The average size is perhaps not greater than that of a walnut, though locally the gravel is coarser and individual bowlders of quartzite may weigh 50 pounds or more.

An almost constant attendant of these gravels is a highly ferruginous sandy loam, generally of a bright orange or brown color and, although in appearance almost a pure sand, containing enough clay to make the mass plastic. In some places this loam occupies a position above the gravel, as at Grover, 2½ miles north of Glencoe, in the O'Fallon quadrangle, adjoining the St. Louis quadrangle on the west; in others it is interbedded, as at the banks 2 miles farther west. Thinner beds of light-colored plastic clay occur here and there, some of them broken into angular blocks whose surfaces have the almost omnipresent ferruginous stain. The whole formation is in different places clearly bedded, cross-bedded, or thoroughly unassorted. The observed thickness is nowhere more than 30 feet. The gravels rest directly on the Carboniferous or, farther west, on older rocks. Wherever found in the St. Louis quadrangle they are covered by loess. This is likewise the case 2 miles south of Pacific Junction, 34 miles west of St. Louis, but near Ballwin, in the O'Fallon quadrangle, they cap a high hill on which no loess is found.

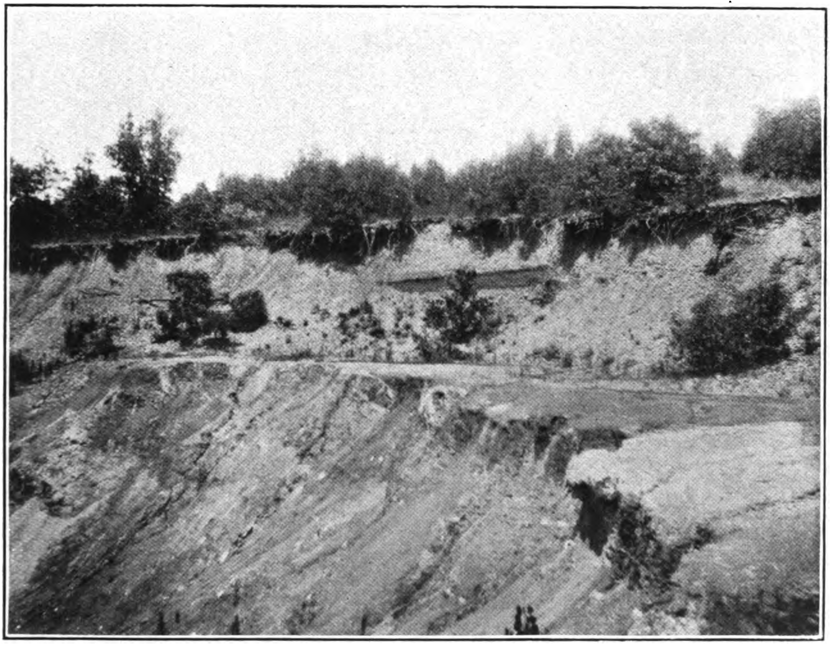
---

[a] This is the opinion of W J McGee and R. D. Salisbury, both of whom are familiar with the Lafayette of the Coastal Plain and accompanied the writer in visits to the exposures west of St. Louis.



A, LOESS ON ST. LOUIS LIMESTONE ONE-HALF MILE SOUTH OF STOLLE, ILL.

(See pages 23, 33.)



B. LAFAYETTE GRAVEL ON CARBONIFEROUS SHALE NORTHWEST OF GLENCOE, MO.

The gravel is interstratified with loamy sand which appears dark in the picture. (See page 30.)

Topographic position.—Topographically these gravels occur on the higher and least eroded remnants of the upland. They may be found at lower levels, though perhaps in a more or less worked over or redeposited condition. At Webster Groves, near the St. Louis and San Francisco Railroad station, they are at a height of 620 feet or more. On the Creve Cœur electric line northwest of Elmwood Park a considerable area over 700 feet high, and therefore slightly above the general level of the upland, is apparently underlain by these gravels, though the thick covering of loess prevents good exposures and, except in wells, the gravel is found only in a redeposited form. The same is true of the high area at Stratmann.

The best exposures of the Lafayette are found in the O'Fallon quadrangle. Two miles northwest of Ballwin an isolated hill less than half a mile wide at the base rises to an elevation of more than 750 feet, being at least 50 feet higher than the surrounding upland. This hill is capped with about 30 feet of gravel, near the base of which issue springs. The excellent exposures at and west of Grover are on the remnant of upland, above 750 feet in height, which divides the waters flowing northward to the Missouri from those flowing southward to the Meramec. At a point 2 miles south of Pacific Junction another deposit is present in the Meramec Valley at a much lower level than those farther east, despite the general rise of the upland toward the west. The top of this deposit is not more than 500 feet above the sea and it constitutes a terrace in the present valley of the Meramec. It is possible that this material represents a redeposition of the Lafayette gravel, but in all physical characteristics it is identical with the Lafayette and there is no reason except its topographic position to assume a working over of the materials. (See p. 45.) The gravel at this place is almost exclusively chert, but includes a few pebbles of quartzitic sandstone.

QUATERNARY SYSTEM.

PLEISTOCENE DEPOSITS.

The vicinity of St. Louis is a somewhat critical locality with respect to Pleistocene deposits. It apparently contains the thin edge of the Kansan drift sheet, which came from the northwest, and that of the Illinoian drift, which came from the northeast. Loess covers the entire area embraced in this study.

KANSAN DRIFT.

At several points near the northern margin of the area are exposures of sand or gravel composed in part of igneous particles whose appearance suggests the Kansan drift as known elsewhere. The prominent characteristics of these sands and gravels are the extreme oxidation of the ferromagnesian minerals and the complete kaolinization of the feldspars. In the disintegrated remains of such minerals are embedded the quartz granules of the original rock particles. An exposure of such material is seen in the west bluff of the Mississippi about a mile south of the Chain of Rocks (which is just north of the area mapped), at an altitude between 480 and 500 feet. Two miles north of the Chain of Rocks, in the gorge of a small stream, is a similarly old and weathered deposit at an altitude of about 450 feet. This deposit is of coarser gravel than that above mentioned, but does not contain bowlders. It is overlain by a few feet of dark-colored plastic clay and this again by drift believed to be of Illinoian age.

In the bank of Watkins Creek, about 1 mile west of the Chain of Rocks and at an altitude probably as low as 430 feet, or only 30 feet above the average level of the Mississippi, is an exposure of 20 feet of very much weathered gravel similar to that above described, but containing in addition many pebbles plainly derived from the Lafayette. These are quartz, quartzite, jasper, and chert, the last commonly weathered to the familiar chalky white appearance. Dark-colored rocks are very sparingly preserved, and there are relatively few pebbles of granite and pegmatite. The preservation, however, of even a few igneous pebbles in recognizable condition differentiates this deposit from those mentioned above and it is possibly younger. It is overlain by a partly consolidated silt, inclosing pebbles similar to those below but less weathered, and this again by 20 or 30 feet of loess.

It can not be definitely affirmed that any of the deposits here enumerated as of probable Kansan age are ice laid. That on Watkins Creek was almost surely deposited by water and the others may have been.

ILLINOIAN DRIFT.

Glacial drift which is much less weathered than that described above is found at various places in and near the area here treated. The upper deposit mentioned as occurring 2 miles north of Chain of Rocks is of this character. It contains some fair-sized bowlders or fragments of local limestone, which favor the hypothesis that it is an ice-laid deposit. Bowlder clay is found beneath the loess at various places in St. Louis, some of them as much as 4 miles west of the Mississippi. In this clay are foreign bowlders up to 1 foot in diameter. South of Jefferson Barracks the bedrock is at places planed and striated.[a]

---

[a] J. A. Drushell, of the Teachers College, St. Louis, has discovered a number of these exposures. Some of them he has described in Jour. Geology, vol. 16, 1908, pp. 493–498; others in personal letters to the author.

H. A. Wheeler (Trans. St. Louis Acad. Sci., vol. 7, pt. 3, 1905, p. 121) describes the occurrence of a typical bowlder clay encountered in digging a tunnel under Pine street and Taylor avenue. Various igneous rocks which are common in the northern drift are enumerated.

J. E. Todd (Missouri Geol. Survey, vol. 10, p. 162) describes a cut which disclosed beneath the loess 8 feet of "bowldery clay or till" in which a few igneous bowlders were found, though most were fragments of limestone.

G. Frederick Wright noted near Forest Park striated pebbles ranging in size up to 3 inches and some thin limestone chips striated on one side only, perhaps broken from bedrock, and, if so, evidently not transported far.

A. H. Worthen (Geol. Survey Illinois, vol. 1, 1866, p. 314) speaks of "15 feet of common chocolate-colored brown drift clay" exposed in a mound in the northern part of the city, though his language elsewhere does not indicate a sharp distinction among the various classes of surficial deposit known as drift.

East of the river undoubted till of Illinoian age is exposed near Edwardsville, a few miles northeast of the area here mapped. Within the area there are, in the face of the bluff or the ravines which indent it, scattered exposures of glacial drift.

LOESS.

Loess covers all the uplands of this area. Most of the loess on the bluffs has the typical character, which has been so frequently described as to make repetition unnecessary. Calcareous concretions, many of them large and branching, and pulmonate shells are abundant. (See Pl. V. *A*.)

In places the formation is entirely without stratification; elsewhere the typical bluff loess is interstratified with silt or fine sand. Here and there occur thin laminæ of dense clay and horizontal bands of a limonitic crust. The loess is thickest on the east bluffs of Mississippi and Missouri rivers, where, in some places, it is 50 feet thick. Its thickness decreases with increasing distance from the great rivers, averaging 10 or 15 feet at a distance of a very few miles. On the steepest slopes of the Meramec Valley it is generally absent.

Back from the bluffs the loess becomes more clayey. Over most of southern Illinois it is known as the "white clay." What seems to be an extension of the same formation in the Gulf States is known as "brown loam." Every part of the area here treated is so near to the great rivers that these more clayey varieties are not typically exemplified, but a tendency in their direction is clearly observed.

Among the departures from the typical bluff loess character the most noteworthy is a phase of ashy color and generally more silty constitution, in many places showing distinct lamination, but locally interspersed with the typical bluff loess in forms defying generalization. In a large way this aberrant type occupies lower levels, in many places underlying that of the more familiar type and here and there constituting stream terraces, as on the north side of River Des Peres at Carondelet.

The upper 4 or 5 feet of the loess, just beneath the soil, is clayey. It is distinguished by brickmakers from the more mealy material beneath as the "strong clay." This surface phase is apparently due to weathering. Where the loess rests on limestone it commonly shows near its base the effect of admixture with the residual clay of the limestone. This is evident in its generally more reddish color and its greater tenacity. Corresponding effects may be observed where the loess rests directly on the chocolate-colored shales of the Pennsylvanian. In either case some gradation is generally apparent.

In many places a zone of several feet at the base of the loess contains much gravel. The constituent stones are the same as those of the till. In the western part of the area many quartz, quartzite, and chert pebbles appear to have been derived from the Lafayette.

A generalized section of the loess is as follows:

Section of loess in St. Louis quadrangle.

Soil.
Clayey loess—the "strong clay" of the brickmakers.
Typical bluff loess.
Basal portion, locally mixed with residual clay and drift gravels.

RECENT DEPOSITS.

Alluvium of the flood plain.—The flood plain of the Mississippi is composed of 60 to 150 feet or more of alluvium superimposed upon the Mississippian and Pennsylvanian beds. Similar alluvium occupies the valley of the Missouri and a thinner sheet is present along the Meramec and some smaller streams.

In general, the upper 10 or 15 feet of the alluvium is composed in great part of clay and silts of various grades of fineness. These materials are in large measure deposits from suspension in flood waters and are as a rule clearly laminated. Below a depth of 10 to 15 feet the material is prevailingly sand with minor lenses of clay and gravel to a depth of 60 to 90 feet where best known, and possibly to a much greater depth elsewhere. This is chiefly the material deposited on the inside of meander curves and in bars, regardless of overflow, and has in the main been brought to its present position by being urged along the bottom rather than by being carried in suspension.

At depths ranging from 60 to 90 feet where borings are most numerous there is commonly found a coarse gravel which rests upon the bedrock and has a thickness of 10 or 20 feet or even more. This bed is in places composed of cobblestones or even bowlders. This material is continuous beneath the present channel and is moved forward only in extreme floods which scour the channel to bedrock. During the subsidence of the flood the heaviest stones, being the first to come to rest, are left in disproportionate numbers at the bottom. So far as is known, even where the bedrock lies deepest this relation of coarse gravel below and sands above exists. Where the surface of the bedrock lies the deepest the stones of the overlying gravel are the smallest.

Terraces.—Alluvial terraces within the area studied are generally insignificant and are incident to recent meanders. In the notches of the bluff through which certain of the smaller streams emerge there are some remnants of terraces ranging in height between 40 and 80 feet above the great streams at their nearest points. The larger number differ little from 60 feet in height. They are almost universally composed of loess, generally stratified and in places suggesting by its impure character that it has been washed from the neighboring uplands and redeposited. All the material of these terraces may have been similarly redeposited. At one place only, on Feefee Creek near the point where it emerges from the Missouri bluff, such a terrace contains beds of gravel, evidently of glacial origin. About 1 mile south of Chain of Rocks a deposit of fresh-looking sand of glacial origin lies against the west bluff of the Mississippi at a height of approximately 60 feet above the river.

It is not impossible that most of these terraces should be correlated and explained as representing the somewhat aggraded flood-plain levels during the Wisconsin ice epoch, but conclusive evidence is lacking.

STRUCTURAL GEOLOGY.

REGIONAL DIP.

The broad structural features of the area are revealed by an inspection of the geologic map. Unconformities of angle being relatively small, the appearance of coal measures in the north and east and of the lower Mississippian formations in the southwest corner indicates a general northeastward dip—that is, away from the Ozark structural dome and toward the synclinal basin of central Illinois. The structural section shown in Plate VI, *B*, is constructed from outcrops and wells ranged in an almost straight line from Pacific, which is 32 miles in a direct line west-southwest of St. Louis, to Monks Mound, which is 8 miles east-northeast. In this distance of 40 miles the top of the St. Peter declines in altitude from about 550 feet above sea level to 1,540 feet below, an average fall of 52½ feet to the mile. Plate VI, *A*, is a similar section showing dips in a north-northeasterly direction from Crystal City by way of Monks Mound to the Keller oil well, about 2 miles south of Peters station, near the northeast corner of the area. From Crystal City to Monks Mound, a distance of 34 miles, the fall of the upper surface of the St. Peter sandstone is 2,040 feet, an average of 60 feet to the mile. This being the largest dip known for a long distance, it may be taken provisionally as the true dip for strata lower than the Pennsylvanian. Little is known, however, of a possible eastward dip of these strata beyond the Illinois bluffs.

In the northern part of the area traversed by section *A* in Plate VI, the Pennsylvanian has a much smaller dip than the lower series in the direction represented by the section. The decline of the Belleville coal seam in this direction is represented by the line *A*–*B* in the section. Its easterly dip is here much stronger than the northerly dip, the altitude of this seam at Belleville being but 380 feet, whereas in the bluffs near Centerville it is above 500 feet. Whether this represents a difference in direction of dip between the Pennsylvanian and Mississippian rocks can not be determined until more is known of the true dip of the Mississippian. At all events, there is in the direction represented by the section a progressive overlap of Pennsylvanian beds toward the southwest as the Ozark highland is approached.

LOCAL TRANSVERSE FOLDS.

The general northeasterly dip is locally interrupted by at least one minor fold, the direction of whose axis is north-northwest. (See Pl. VI, *B*.) This fold is observable in the west bluff of the Mississippi, the axis of the anticline passing approximately through the Workhouse quarry, opposite the north end of Arsenal Island. It extends thence west of north past the Compton Hill reservoir and dies out in the vicinity of the Grand Avenue viaduct. It is revealed near that place by at least three deep wells and a group of quarries. The amount of local uplift indicated by the log of a deep well at Tamm's glue factory is fully 200 feet. This is near the north end of the anticline, where its height is reduced by a rather sudden pitch. It is quite probable that this fold is continuous across the Mississippi into St. Clair County, Ill. Its extent there is unknown because of the deep mantle of drift.[a] A detailed section along the line represented in Plate VI, *B*, would show much variation in steepness of dip and probably other local anticlines similar to the one shown in the figure. There is, for example, a suggestion of a similar and parallel fold, or at least an arrest of the general northeasterly dip, along the line of River Des Peres about 5 miles farther west.

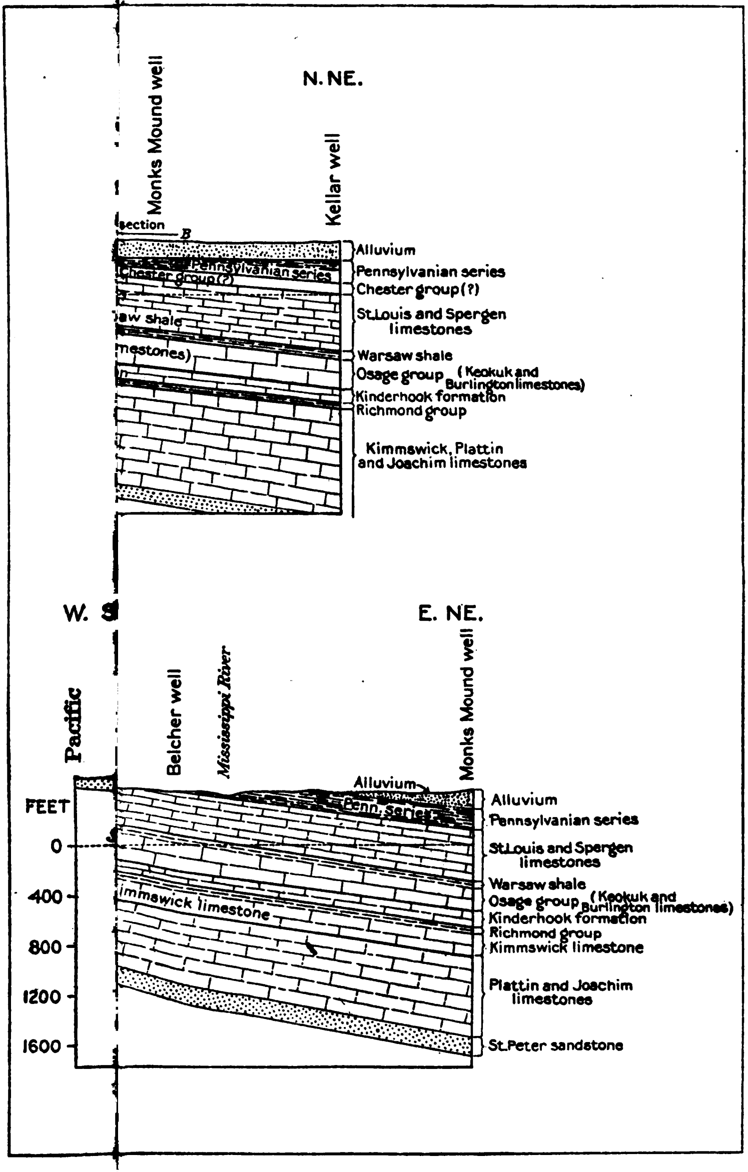
So far as folds of this smaller order are concerned, no discrepancy of angle has been observed between the Pennsylvanian and Mississippian strata. The presence of the former in the Cheltenham syncline likewise seems to indicate that the minor deformation, at least, was accomplished after Pennsylvanian time.

GEOLOGIC HISTORY.

Little can be known from data obtainable within this area of its history previous to the Carboniferous period. The only sources of information are well borings. These, however, indicate the presence of strata which are well known elsewhere in the Ozark region and whose history is to some extent understood. From the presence of these rocks it is safely inferred that the geologic history of the St. Louis area before Carboniferous time corresponds to that of the northeast slope of the Ozark uplift as inferred from the strata which outcrop on its slopes. In interpreting the events of this locality in the light of the provincial history it is remembered that the St. Louis area is far out on the edges of the slope and was accordingly beneath the sea a larger share of the time than the localities to the west and south.

---

[a] Weller, Stuart, Geological structure of the State: Bull. Illinois Geol. Survey No. 2, 1906, p. 22.



MO., TO MONKS MOUND, ILL.

ALGONKIAN TIME.

At some time during the Algonkian period the Ozark region may have been beneath the sea and receiving sediments from lands whose location is but vaguely known. It is highly probable that sediments of this age were deposited in the St. Louis area, though they may have been eroded away during the long land period which followed. From the lowest 40 feet of the well at the insane asylum (3,843.5 feet deep) material was brought up which was recorded as "powdered granite" from the fact that it contained "red quartz or feldspar."[a] The rock was red and hard, but its features were evidently indecisive and its granitic nature was disputed by Professor Hambach, of Washington University, who studied all the samples carefully. The bit of pre-Cambrian history, therefore, depending on the presence or absence of Algonkian sediments at this place remains unknown.

CAMBRIAN LAND INTERVAL.

Cambrian sediments do not appear in Missouri before the middle of the period, their absence indicating a long period of land conditions perhaps embracing a large part of Algonkian time. During this time any Algonkian sediments must have been in large part washed into the sea and the Archean below still further wasted. Along with the wasting of the land by erosion there was doubtless a gradual settling down and surely a rising of the sea level, so that in Middle Cambrian time the Ozark region, and with it the St. Louis area, became submerged.

CAMBRO-ORDOVICIAN SEDIMENTATION.

FORMATION OF MAGNESIAN LIMESTONE.

From this time to the close of the Ordovician period the slopes of the Ozark were submerged almost continuously, though occasional minor uplifts exposed them to surface erosion. During most of this time the shore was so remote or the land so low that there was but little terrigenous sediment to accumulate on the bottom or mingle with the constantly deepening calcareous ooze which was subsequently consolidated into magnesian limestone. During the continuance of such conditions nearly 3,000 feet of sediment slowly accumulated in the St. Louis area, more than three-fourths of which is limestone.

SANDSTONE MAKING.

At intervals temporary uplifts of the Ozark and more distant lands steepened the stream profiles and gave new impetus to erosion and transportation, at the same time narrowing and probably shallowing the seas so that beds of sand were laid down. The occurrence of such conditions on a very small scale was frequent, but there were four epochs during which the effect was especially noteworthy, the resulting sandstones being widespread and ranging in thickness from 50 to 300 feet.

---

[a] Broadhead, G. C., On the well at the insane asylum, St. Louis County: Trans. St. Louis Acad. Sci., vol. 3, 1873, p. 218.

The first of these four sandstone-making epochs was the later Cambrian and the last was the St. Peter.[a] At the beginning of the St. Peter epoch a very broad area was out of water, as is known from the eroded surface of the magnesian limestone below. Locally at least, and probably over much of the Ozark region,[b] the St. Peter sands were themselves exposed to surface erosion before the overlying limestones were deposited. At Pacific an unconformity of angle amounting to 10° or 15° indicates considerable crustal movement attending the land interval which followed the St. Peter. (See Pl. III, *A*.)

This epoch is remarkable as one of clear seas in which a moderate amount of sand and but very little mud were delivered to the sea. The unusual roundness of the sand grains indicates that they had been much handled by wind on the beach before submergence. They were then washed over and over by the waves until all finer material was carried away in suspension. The resulting deposit offered to the subsequently percolating water little silica in soluble form, and is therefore poorly cemented. Moreover, the extraordinary roundness of grain adds to the weakness of the poorly cemented stone.

It may be that the distinguishing process of St. Peter time—namely, the thorough rounding of the sands by wind and assortment by water—was not carried on along a single shore line from which the sands of the entire formation were derived, but that this shore line advanced across the area with the gradual submergence of the land, and that therefore the exact age of the formation varies from place to place. There is nothing to show that the entire Ozark region was ever covered by these sands, hence the St. Francis Mountains may have remained a source of sediment throughout the epoch.

MIDDLE ORDOVICIAN EPOCH.

The broad, clear, and perhaps deeper seas which followed the St. Peter in the Joachim, Plattin, and Kimmswick epochs differed little from those of preceding limestone-making epochs, but, whether from a difference in conditions at that time or subsequently, the limestone which accumulated in the later epochs contains less magnesia, being in part an almost pure carbonate of lime.

The exact extent to which these and the preceding seas and their sediments covered the Ozark highland is not determined. Opportunities for subsequent erosion have been so great that complete removal of thick strata would not be surprising.

---

[a] It should be noted that these four limestones and four sandstones are frequently known by number, beginning at the top, so that the St. Peter is, in the older publications, commonly called the "First" sandstone. (See geologic column, pp. 13-14, also well section, pp. 16-17.)

[b] Broadhead, G. C., Geological history of the Missouri Paleozoic: Am. Geologist, vol. 14, 1894, p. 384.

LATE ORDOVICIAN SHALE MAKING.

Following the middle Ordovician and including a long period of land conditions came a gentle rise of the Ozark area which enabled the streams to bring down to the sea some of the residual clays and muds that had been long accumulating on the land while the land was low, the streams sluggish, and the seas almost free from terrigenous sediment. The accumulation of this mud made the shales of the late Ordovician, represented by the Maquoketa shale near Kimmswick. These deposits may have been much thicker than the remnants now seen, for they were in part carried away as the result of the continued uplift which exposed them to erosion. It is now known that the seas of this epoch and the preceding middle Ordovician were continuous to the west beyond the middle of the State.[a]

SILURIAN-DEVONIAN LAND PERIOD.

During the Silurian period the Missouri land was higher and broader than in the preceding periods, the shore probably being a little northeast of the site of St. Louis, though at the time of broadest Silurian seas the shore was probably curved round the Ozark Island and was not far distant from the area here considered. If this area was at any time submerged, the accumulated sediments were eroded away before the deposition of the Carboniferous beds.

If at any time during the Devonian period the seas covered the site of St. Louis, the sediments of such time were muds which have been consolidated into shales not now clearly distinguished from those of the Ordovician below and the Carboniferous above or have been removed by erosion. Such shales are discovered only in wells and do not contain recognizable fossils. (See pp. 14–18.) During the early Devonian the sea on the east seems not to have come farther west than the foot of the eastern slope of the Ozark, and the sea on the west communicating with the Pacific was far removed. Later these two seas came very near together. Strata deposited in the eastern sea are present along the Mississippi a short distance southeast of St. Louis and others whose fossils show that they were laid down in the western sea occur a few miles west and north of St. Louis, along Missouri and Mississippi rivers. The isthmus separating the two seas and connecting the land in Missouri and the Southwest with that in Wisconsin and farther north seems therefore to have embraced the area treated in this report. In late Devonian time this isthmus was in the main submerged and if the shales pierced by deep wells are indeed Devonian they probably belong to this epoch of submergence in the later part of the period.

---

[a] Broadhead, G. C., Geological history of the Missouri Paleozoic: Am. Geologist, vol. 14, 1894, p. 384.

CARBONIFEROUS SEDIMENTATION.

MISSISSIPPIAN TIME.

KINDERHOOK EPOCH.

With the beginning of the Carboniferous the Ozark land area, which had persisted throughout Silurian and Devonian time, began again to be depressed. Within the St. Louis quadrangle it was borne downward as it had been borne upward, with little or no folding. The shales of the late Ordovician were brought again into essentially the position from which they had been lifted up. Though their thickness preserved is small, the area over which they remain is large. From similar evidence it appears that the land over which the early Carboniferous sea advanced was in this vicinity one of small relief. However, relief was not entirely lacking on the pre-Carboniferous land, and as a result the invading sea was locally and temporarily quiet and free from terrigenous sediments, while elsewhere it was probably shallower and more agitated and received deposits of sand. These conditions are reflected in the distribution of thin and local limestones and sandstones like the Glen Park and Bushberg members of the Kinderhook formation. (See pp. 19-20.)

The first deposit of wide extent in the advancing Carboniferous sea was one of shale and shaly limestone having a reddish color, the Fern Glen limestone member of the Kinderhook formation. This color may be due to the long exposure and thorough oxidation of the mantle rock during the Silurian and Devonian land interval. The surface materials thus exposed and oxidized became a source of the early Carboniferous sediments.

OSAGE EPOCH.

The passing of the Kinderhook epoch into the Osage was marked by a diminution of muddy sediment from the land and a disappearance of the red color of the sediments. Marine conditions and sedimentation were uninterrupted during the deposition of the several hundred feet of limestone marked by Burlington and Keokuk faunas. Some time before the end of the Osage the Spergen fauna (pp. 23, 41), which was already flourishing elsewhere, made an incursion into this territory and left its remains in a 2 or 3 foot bed of limestone about 50 feet below the summit of the Keokuk. Conditions quickly reverted, however, the Spergen fauna disappearing.

The ooze of this epoch, or the water circulating through it both during its deposition and later, contained an extraordinary amount of silica in soluble form, probably derived from siliceous skeletons. This silica aggregated in the form of chert.[a] Doubtless some strata were richer in this substance than others when the deposit was made, but transfer and substitution of material by ground waters probably made these strata even richer in silica while removing their lime carbonate. As a rule this work of ground waters in aggregating the silica at one place is made apparent by a nodular or concretionary form. Between the continuous band or bed and the isolated nodular concretion there are all gradations.

---

[a] A study of the cherts of the limestones of Missouri has been made by E. O. Hovey, who has also reviewed the theories of their origin. See Missouri Geol. Survey, vol. 7, pt. 2, 1894, pp. 727-739.

WARSAW EPOCH.

At the close of the Osage and the beginning of the Warsaw a moderate rise of the land caused mud to be again washed down into the sea. At intervals this mud greatly predominated over the calcareous ooze which continued to accumulate. The resulting Warsaw formation is therefore in large part shale. At certain intervals when the sea was clearer animal life was very abundant.

SPERGEN EPOCH.

The continued wearing down of the land, aided perhaps by slight depression, caused a dominance of limestone making again in Spergen time, though locally and at intervals mud continued to accumulate. That the waters were shallow even during the deposition of limy ooze is plain from the clearly marked and abundant cross-bedding of the limestones. That terrigenous sediments should be absent from such shallow waters indicates that the land was very low.

The shallowness and doubtless the warmth of Spergen waters made this epoch very favorable to life. Moreover, the same conditions were uniform over wide areas, for assemblages of the same forms prevailed at widely separated places. A collection of Spergen forms from the Meramec Valley would be very similar to a collection from Spergen Hill, Ind., where the life of this epoch has been studied in detail.

ST. LOUIS EPOCH.

The physical conditions prevailing in the Spergen epoch continued into the St. Louis epoch. As indicated by abundant cross-bedding and some beautiful ripple marks, the water continued shallow, though almost free from land-derived sediments. Parts of the formation abound in chert, indicating a revival of the conditions that gave the large silica content to the waters and ooze of the Osage sea.

Certain conditions not generally present in the preceding epochs caused in St. Louis time the accumulation of excessively fine calcareous mud which hardened into rock having the texture of lithographic stone. Chemical precipitation has been suggested to account for certain similar sediments elsewhere, but it is rather more probable that a slight emergence of the calcareous bottom from another portion of the St. Louis sea caused the sediment to be reassorted, its finer parts being carried to this area in suspension. In conformity with this supposition are the general thinness of the beds of this dense limestone and its interbedding at many places with very fine mud.

Not uncommonly the dense limestone of lithographic texture is found in small irregular bodies or lenses not larger than a man's hand, embedded in the coarser granular limestone of the ordinary type. The local brecciation of the dense limestone (see p. 24), as well as the faulting of chert bands, favors the supposition that these embedded bodies were consolidated earlier than the granular matrix, which shows no evidence whatever of deformation. No cause is suggested for such brecciation other than the slight movements incident to settling and crystallization. The movement, whatever its nature, did not affect the horizontality of the beds above and below.

CHESTER EPOCH.

The St. Louis epoch was followed by a very general shallowing of the Carboniferous sea and a broadening of the Ozark land, which caused sand to accumulate in and around the St. Louis area. This condition, accompanied by a change of fauna, marks the Chester epoch.

MID-CARBONIFEROUS LAND EPOCH.

The uplift which narrowed and shallowed the seas during Chester time foreshadowed the greater uplift at its close, whereby a large part of the area covered by the Mississippian sea became land and the strata were locally tilted and folded. With this rise of the land a part of the regional dip toward the northeast was imparted to the Mississippian strata of this area. Next came a long epoch during which the landward edges of the several Mississippian formations were beveled by erosion. In this process the edge of the Chester, if that formation once covered the area here treated, was worn back to the northeast corner, the portion of the area to which the rocks of this age seem now confined.

PENNSYLVANIAN TIME.

When the land was again submerged it was subjected to those remarkable and exceptional conditions which prevailed at the beginning of the Pennsylvanian coal-making period. The general surface of the land was so nearly horizontal that swamps existed over very wide areas. The water of these swamps was fresh and the vegetation suited to it, but at intervals the continued or periodic sinking carried the surface below sea level, and shales, sandstones, or limestones which carry marine fossils were formed. In these swamps vegetation accumulated to form peat, which by subsequent burial and consolidation became coal.

Beneath a bed of peat, or even a sheet of swamp water which is charged with the organic acids that characterize peat, the alkaline constituents of a clay bed may be exhausted to neutralize such acids. The alkaline or metallic constituents in the clay act as fluxes, making the clay more fusible. The removal of the alkalies is therefore one important element in the origin of fire clay. Another is the removal of the iron by carbonation and solution. Both these processes are favored by swamp conditions. Such conditions caused the refractory character of the widespread clay bed known as the Cheltenham fire clay (pp. 28, 50). Locally there was a growth of vegetation and an accumulation of peat just above this clay. In such places the roots which entered the clay aided in extracting from it the constituents that act as fluxes, most of which are also plant foods. Over most of this great bed, however, there is little or no coal; hence its refractory nature is not due to the action of roots but solely to leaching by swamp waters.

The sinking of the region during the coal-making period again greatly narrowed the land, if indeed this was not at times quite submerged. Remnants of sediments of this age are found high on the Ozark flanks, though the highest have not been shown to contain marine fossils and may therefore represent isolated basins which were not depressed to sea level. At some places these deposits rest directly on the magnesian limestones of the Cambro-Ordovician, thus overlapping the Mississippian limestones. It is probable, however, that the seas of Mississippian time were at least as widespread as those of the coal-making period, and that the Mississippian sediments were eroded during the land epoch which intervened.

POST-CARBONIFEROUS UPLIFT AND PENEPLAIN.

The great uplift which followed the coal-making period ended the marine history north and east of the Ozarks. Not only was the region elevated, but minor folding was produced. (See p. 36.) No record of the events of Mesozoic time is left in this region. Probably land conditions and erosion were general, but the process was no doubt one of varying rapidity. Warping may have been renewed at various times, and several cycles of erosion may have been approximately or locally completed. Evidence derived from the present topography shows simply that in relatively recent geologic time the entire Ozark area, together with the surrounding regions, was denuded to a peneplain. It is this peneplain whose fragments still remain as the upland that is visible in the sky line in all directions from St. Louis. (See p. 9.) Over wide areas it may be coincident with the upper surface of a resistant stratum which is nearly horizontal and which lay near base level when the peneplain was made. Elsewhere it may cut sharply across strata that are steeply upturned or bevel to a thin edge those which are gently inclined. The making of this peneplain appears to have been completed in Tertiary time. It is not improbable that the peneplain seen at St. Louis is a part of the one whose remnants are visible throughout the Ozarks.

Many parts of the United States are known to have undergone peneplanation in or about the Cretaceous period and to have been subsequently elevated and partly reduced to base level again before the close of Tertiary time. The absence of two peneplains in the northern Ozark region leads to the inference that if this region was base-leveled in Cretaceous time, the peneplain then produced was not uplifted, but remained approximately at base level until late in the Tertiary.[a]

LAFAYETTE EPOCH.

In the Pliocene period, when the land seems to have been for a long time at a low altitude as the result of denudation, a gentle upward crustal movement steepened the grades of some of the streams. These began thereupon to bring down pebbles which could not be transported by the sluggish streams on the old peneplain but which, being insoluble (see p. 30), failed to decompose and hence accumulated in the thickening mantle rock as the mud was gradually washed out. Stream-laid deposits of these pebbles seem to have been superimposed on local residual deposits. This gravel was accumulated near St. Louis to a depth of at least 30 feet.

This formation has sometimes been regarded as a marine deposit, a theory which, on the whole, is less satisfactory for this area than that stated above. The writer does not believe, however, that the study of the Lafayette remnants in this area is a sufficient basis for a comprehensive theory of the origin of this formation. The statements here made therefore apply only to the features of the formation in this locality. No theory is entirely without difficulties. The source of some of the constituent pebbles of the gravel is obscure. This is notably true of certain quartzites and jaspilites which resemble no known formation nearer than the Lake Superior region. Their transportation in large numbers for so great a distance would be remarkable, especially when it is remembered that some of them weigh more than 100 pounds. Streams can deposit sheets of gravel only when they are overloaded and, in extreme cases, branch out into distributaries as on an alluvial fan.[b] The conditions for aggradation and the ability to transport such large stones are difficult to reconcile.

The occurrence of this gravel at an altitude of over 750 feet near Grover, 4 miles northwest of Glencoe, and again at less than 500 feet near Pacific, which is southwest of Grover, has an apparent bearing on its origin. If the gravel is a marine sediment it could not have been deposited in a layer of nearly uniform thickness at such diverse altitudes. Change of level by warping subsequent to sedimentation can not be invoked as an explanation, for the general level of the old peneplain, which antedated the gravel, still declines slightly to the east or northeast. It is possible to explain the deposition of the gravel by rivers by assuming that the several patches represent the simultaneous alluviation of independent valleys of different depths. This would imply, however, that the formation was made after the dissection of the peneplain—a theory that would involve grave difficulties. It remains to assume that the valley of the Meramec at Pacific is younger than the Lafayette gravel and that the apparent Lafayette sediments which constitute a terrace within it represent a redeposition of Lafayette material or are derived from a similar source at a later time. A second marine invasion can scarcely be supposed and the fluviatile origin of the deposit near Pacific is probably beyond question. Its significance consists in showing that the exact features of the typical Lafayette may be reproduced by stream deposition. The case is not essentially altered by assuming that the materials in question were derived from the original Lafayette. There is therefore no reason, so far as local evidence is concerned, for assigning different modes of deposition to the gravel at Pacific and that farther to the northeast and at a higher level.

---

[a] Compare Keyes, C. R., Composite genesis of the Arkansas Valley through the Ozark highland: Jour. Geology, vol. 9, 1901, p. 486.

[b] A conception of the manner in which the Lafayette gravel may have been deposited in extended sheets by rivers is given by Chamberlin and Salisbury (Geology, vol. 3, p. 305).

POST-PLIOCENE UPLIFT.

After the making of the peneplain and the deposition of the Lafayette gravel the country was again uplifted. This uplift, like some of the preceding, renewed the dome in southern Missouri and tilted the peneplain in an easterly direction within the area studied. The valleys which now affect the underlying rocks beneath the glacial drift and loess were cut mainly since this last general uplift. Doubtless the altitude has varied somewhat since the rise of the land at or near the close of Pliocene time, but for the cutting of the rock valleys it is not necessary to assume that it has at any time been higher than at present.

PRE-QUATERNARY DISSECTION.

The courses of the streams which began work on the newly elevated land probably bore little resemblance to those which had base-leveled the country before the close of the Pliocene. The surface slopes of the Lafayette gravel controlled the smaller streams of the new systems. Percolation must have been very large, direct run-off small, and tributaries to the revived streams relatively few. Streams were, however, gradually elongated headward and tributaries became more numerous. Before the beginning of the glacial period this process had gone so far that the dissection was approximately mature, the original surface of the peneplain being only approximately preserved on the divides. During the same interval the channel of the Mississippi, which in Lafayette time must have been but little below the general surface, was cut almost to its present depth.

GLACIAL HISTORY.

KANSAN EPOCH.

The ice sheet of the Kansan epoch came from a northwesterly direction and in its extreme advance its front stood in or near the area here described. No recognizable topographic effect of this occurrence remains, but the presence of Kansan drift, whether ice-laid or water-laid, at an altitude of only 30 feet above the Mississippi is important in showing the depth to which the valley had been incised before that time.

ILLINOIAN EPOCH.

The Illinoian ice sheet came from the northeast, its front standing for a considerable time near the line of the Illinois bluffs. It seems to have crossed the river for a short time and doubtless left the small bodies of drift which have been found here and there beneath the loess in and near St. Louis. Like the older invasion, it left no recognizable topographic effects on the Missouri side of the river. On the Illinois side the glacial deposit is many feet thick in places, and has no doubt assisted in leveling the country by filling the preglacial valleys. Its real distribution is, however, obscured by the thick covering of loess. In fact, the amount of drift definitely known to be present within the area studied is insignificant.

LOESS EPOCH.

At some time after the deposition of the Illinoian drift, and possibly in connection with a succeeding pre-Wisconsin stage of glaciation, amounts of finely powdered rock flour hitherto unequaled were spread out by the combined agency of streams and winds. The greater thickness of this deposit near the great streams indicates that their agency was primary in transporting this fine silt; the manner of its distribution over hill and valley points to the work of the wind.

The vicinity of St. Louis exemplifies typically the distribution of the loess and therefore presumably also the manner of this distribution. Its thickness is greatest where it caps the bluffs and is greater on the east bluff than on the west. The extreme thickness is generally found within a small fraction of a mile from the edge of the bluff and in places reaches 50 feet or more. A mile farther from the river it is in most places but 10 or 20 feet thick, thus giving locally to the upland surface a slope of 30 or 40 feet away from the river within the first mile. This feature is conspicuous on the east bluff, not only within this area, but at numerous places from Iowa down to the Delta. On the west bluff this phenomenon is very inconspicuous.

This loess was doubtless brought down as mud suspended in the river. The loaded condition of the stream, implied in the handling of so much detritus, doubtless caused aggradation of its valley bottom. Under these circumstances floods must have habitually spread the fine detritus over the broad alluvial plain, leaving it to dry in the intervals between floods. Thence it was carried by winds over the uplands, the greater thickness on the east bluff being the result of the first settling from the prevailing westerly winds. In the East St. Louis district the loess on the bluff is thickest where the flood plain is widest, and it is possible that the greater thickness may result from the greater expanse of mud flat from which material was gathered.

Some of the loess that is clearly and minutely stratified or interlaminated with fine clay apparently still lies where it was originally laid down by the glacial stream. Other deposits similarly stratified may have been formed at the same time by side streams which washed back to the main valley the material carried by wind into their drainage basins. Still others are the work of later streams working on the original deposit. It is difficult to distinguish an original deposit of loess from one which has been worked over, and therefore it is not now possible to name any level beneath which the loess may have been deposited by streams and above which it must have an eolian origin. On the whole, distinct and horizontal stratification is found in the valleys of the great streams and at the lower levels.

WISCONSIN EPOCH.

The Wisconsin stage of glaciation is represented in this area only by the materials which were washed outward from the glacier. They consist of small patches of sand and gravel, the freshness of whose minerals indicates relatively recent age. These deposits occur in the Mississippi bluffs. From even the fragmentary data thus far obtained, it seems safe to assume that during the Wisconsin epoch the immediate valley of the Mississippi was aggraded to a height at least 30 or 40 feet above its present flood plain.

The terraces in the recesses of the bluffs where small streams emerge are composed almost entirely of loess, which, to judge from the topographic forms and from a local admixture of other material, may be supposed to have been gathered by the smaller streams from their basins and redeposited at the flood level of the larger stream. The highest remnants of such terraces are about 80 feet above the great rivers. It is not improbable that some of these represent the flood levels of the great streams in the Wisconsin epoch.

POSTGLACIAL EROSION.

STAGE OF DISSECTION.

The larger streams, including the Meramec and River Des Peres, and even some of smaller size have cut entirely through the loess mantle, so that their channels are on bedrock or recent alluvium. In the rest of the area, away from the immediate channels of the more active streams, the uniformity and continuity of the loess cover over hill and valley are remarkable. The smaller valleys still have loess bottoms, and the mantle may be thicker here than on the intervening hills. With the exception of the smallest valleys and recent gulleys, the location of the present drainage lines agrees essentially with that of their preloessal ancestors. It is certain that the loess never entirely filled the valleys of the former upland surface. It is fair to assume that the accumulation on the upland, where wind was the transporting agent, was so slow that contemporary run-off maintained in the most part the old drainage lines. Many of the smaller valleys were doubtless left deeper and steeper than they now are, subsequent creep having partly filled them and reduced their slopes. Where the drainage is at all active, however, the channels are progressively deepening and elongating headward while the side slopes have become steeper and convex upward; that is, their steepness increases as the stream is approached. (See p. 10.)

The stage of dissection in the present cycle is probably not very different from that of the previous cycle, which was partly interrupted or deranged by the deposition of the loess. Dissection is essentially complete and the divides are narrow, though the limitations of run-off, owing to the ready percolation, prevent minute dissection.

MISSISSIPPI TROUGH.

As indicated in the description of the alluvial deposits (p. 34), the Mississippi is still engaged in corrading the bedrock beneath the alluvium over which it flows at ordinary stages of water. This is partly demonstrated by soundings which have been taken during floods and by which it has been shown that the scour reaches to bedrock; but more satisfactory evidence is derived from the polished and perfectly fresh condition of the bedrock where it is exposed in the building of bridge piers. The cobblestones or bowlders of the overlying gravel are likewise fresh and bear the appearance of being periodically moved and worn. It is to be remembered, however, that the deepest part of the alluvium-filled trough is some distance east of the present channel and may be fully 100 feet deeper than the rock surface beneath the present channel. If, however, the river with its present amount of fall has been able to cut its rock trough to essentially its present depth, it may safely be affirmed that it has not had a gradient significantly greater than the present one since it has followed its present course. Had the land stood higher for any considerable time, the rock trough would have been cut deeper than it now is.

ECONOMIC GEOLOGY.

CLAY.

FIRE CLAY.

The fire-clay industry bears a peculiar and interesting relation to the historical and structural geology of the St. Louis area. The clay is found only in the Pennsylvanian strata, a small patch of which has been preserved in St. Louis County because of a slight downward folding. Elsewhere in eastern Missouri these beds lay above base-level during the long period of erosion which in or before Tertiary time reduced the country to a peneplain. They were therefore planed off, but this small patch lay about 100 feet below the level to which streams could cut.

The output of clay products from St. Louis was, in the year 1908, valued at $5,000,000. This is about one-thirtieth of the entire output of the United States. The products here counted comprise those of fire clays, shales, and brick clays. Inasmuch as a very large proportion of the total consisted of fire-clay products, and as these were derived in large part from a single area within the city limits, it may be seen that this area is one of the most important centers of the clay industry.

Mining operations.—The clay is mined like coal from a depth generally less than 100 feet. Both shafts and slopes are used. The mines are owned either by the companies that manufacture the clay products or by independent firms and companies that sell clay to the manufacturers. Following is a list of the chief fire-clay mines in operation when the field was visited, many others having been worked out or closed:

Fire-clay mines in and near St. Louis.

Christy Fire Clay Co.	4000 Kingshighway boulevard.
Goetz	Sublette and Pernod avenues.
Humes	Sublette and Fyler avenues.
Parker & Russell	Morgan Ford road and Potomac street.
Parker & Russell	Fyler avenue west of Kingshighway boulevard.
Van Cleave	Old Manchester and Watson roads.
Krümmel & Büchner	Columbia avenue and Woods street.
Guelker	January and Elizabeth avenues.
Laclede No. 1	Wilson avenue near Sulphur avenue.
Laclede No. 2	River Des Peres east of Sulphur avenue.
Evans & Howard No. 11	Manchester avenue west of Billon street.

Roberts (Hiram)	Victoria avenue west of Billon street.
Van Cleave	Dale avenue near Louisville avenue.
Missouri Fire Clay Co	Louisville avenue north of Dale avenue.
Hydraulic Press Brick Co. No. 4	Kingshighway boulevard and McRee avenue.
Stuever (A. C.)	Maclind avenue south of Forest Park.
Jamieson-French	Hauley road and Bruno avenue.
St. Louis Clay Burning Co	Castello (near Creve Cœur Lake).
St. Louis Vitrified & Fire Brick Co	Castello.

Stratigraphic position.—All the fire clay of the St. Louis quadrangle comes from a single bed known as the Cheltenham bed, for the reason that it is best known and most worked in Cheltenham, a district within the limits of St. Louis, south of Forest Park. This bed lies near the base of the Pennsylvanian. The overlying beds are enumerated in the section on page 25. The sections on pages 25–26 show typical examples of the beds which must be passed through in shafting to the fire clay.

Thickness.—The thickness of the Cheltenham bed varies from 1 to 12 feet within a small fraction of a mile. In few places within the area of its occurrence does it pinch out entirely. Most of the mining is done where the thickness ranges from 3 to 8 feet; where it exceeds that amount, as at the northeast corner of the area, only about 8 feet from the best part of the seam is generally mined. Near the center of the area—in the vicinity of the Laclede mine and those within 1 mile to the south of it—the thickness averages about 7 feet, all of which is good clay and is taken out. The bed is mined at some places where its thickness is as small as 2½ feet. It is commonly observed that where the bed outcrops it is increased in thickness by the weathering processes. Along River Des Peres through Cheltenham this thickening perhaps amounts to 1 foot, being from 12 to 15 per cent of the original thickness.

Roof.—The variable thickness and changeable character of most of the beds above the clay are of little importance, but the character of the roof is a matter of much concern. The shaly and locally micaceous sandstone listed as No. 6 in the general section (p. 25) is the bed which in all mines supports the overburden and under which all posts must be set. Its thickness ranges from 1 to 7 feet, and it is generally sufficently strong to span all entries and rooms; but when the pillars have been mined out, it breaks off short and falls, allowing the overburden to fall in behind the line of supporting posts. The mining is planned with this in view. The roof is more apt to be too strong than too weak, and in that case it does not break short just behind the row of posts, but sinks down over a large area, squeezing the unmined clay and probably breaking the posts.

Floor.—The floor of the mine is generally the light-colored pyritiferous sand mentioned on page 25 as No. 2. At some places the pyrite is oxidized and the sand is yellow. Here and there, especially where the fire-clay bed is very thick, its basal portion is sandy and abounds in pyrite, and is thus poorly distinguished from the underlying sandstone. At other places, as in the Christy and Evans & Howard No. 11 mines, this basal clay is green and very sandy, locally oxidized to yellow and brown colors. At the latter mine and at the Parker & Russell mine, west of Kingshighway boulevard, this basal clayey mass contains large red cherts, which elsewhere (in the Laclede, Christy, and Jamieson-French mines) are found only in the underlying limestone.

Local interruptions.—The surface of the floor is locally affected by gentle ridges or rolls rising from a few inches to 1 or 2 feet in a width of a few yards. One such ridge in the floor of the Jamieson-French mine reaches the roof, cutting out the clay entirely. It is known as a "whaleback." Its trend is northwest and southeast.

In several places the roof thickens, its surface being depressed almost or quite to the floor. Such an occurrence in the Hume mine, south of the insane asylum, affects a band some 200 feet wide trending northeast and southwest. Here, as in a similar occurrence, in a group of mines near the southeast corner of Forest Park, the lower surface of the horse is longitudinally grooved or fluted on a large scale.

Water.—On account of the high degree of imperviousness of the overlying beds, most of the mines are practically dry until the pillars have been drawn from some portion, thus allowing settling and cracking of the higher beds. When this stage has been reached, if not earlier, it is necessary to operate pumps continuously. It is common to dig sumps in various parts of the mine and pump from these. Some mines may be pumped from a single sump.

Grades of clay.—The clay bed is rarely of uniform quality throughout its thickness. Its usual variations are due to varying proportions of silica and carbonaceous matter and to the presence or absence of pyrite and other forms of iron. In the western part of the field pyrite, the chief impurity, is found mainly in the upper part of the bed. The lower clay is the highest in grade. It is probable, however, that in this section several feet remaining as floor should be correlated with the basal portion of the bed in Cheltenham. In that district it is common to regard the middle part of the seam as the best, the top being liable to contain carbonaceous matter and the basal portion being siliceous. In the southern part of the field it is customary to consider the clay in two portions, the upper being the higher in grade and the lower being lighter colored and more siliceous.

Uses.—The choicest of the clay is sold for glasshouse use. At several of the mines the clay is assorted, that which is freest from impurities being sold in the raw condition for glass pots. Good clay which contains a small amount of impurity is washed and then sold for the same purpose. For fire brick it is not necessary that the clay be so pure. Much of the fire clay mined in Cheltenham is used without assorting, for ornamental and facing bricks, or is mixed with various other clays to make sewer pipe.

Distribution.—The area from which fire clay is derived has its center in a section of the city known as Cheltenham, lying south of Forest Park. It extends some 4 miles to the southeast in a belt about 2 miles wide; also westward to a line running south from Clayton. An examination of the geologic map (Pl. I) will show that this area is an extension or peninsula of the Pennsylvanian rocks.

The principal geologic condition accountable for the presence of the fire clay within the area named is a faint syncline (see Pl. VI, *B*) whose axis, trending north-northwest, passes not far from the southeast corner of Forest Park. North and east of this point there are no mines. Still smaller folds are probably accountable for certain small variations from the general structure here described, but such folds are too small to be reduced to system with any data now obtainable. The lowest level from which the clay is mined is 404 feet above the sea, at a point within the bend of River Des Peres, near the southeast corner of Forest Park. From this point the elevation of the bed increases both to the west and to the south. The highest known level of the clay is 494 feet, in the Van Cleave mine, about a mile northwest of the insane asylum, near the intersection of Old Manchester and Watson roads. West of that point the strata are affected by a gentle anticline over which River Des Peres flows toward the southwest, the combined effects of the folding and erosion being that the clay is absent from this area. Similar conditions on the east and south of the productive area have caused the complete erosion of the clay-bearing rocks.

The productive area south of Clayton lies beyond the low anticline above mentioned from which the Pennsylvanian rocks have been stripped. The northerly pitch of these exceedingly gentle folds has caused them to disappear just south of Forest Park, thus leaving the Cheltenham district connected by continuous Pennsylvanian strata and probably by a continuous bed of fire clay with the district south of Clayton which contains the Jamieson-French mine.

At Castello, about 9 miles northwest of Cheltenham and 3 miles east of Creve Cœur Lake, the St. Louis Vitrified and Fire Brick Company operates a mine and factory. That the horizon of the clay here mined is the same as that of the Cheltenham fire clay is practically certain from its relations. The base of the fire-clay bed at this point is nearly 90 feet below the upland level; the dip is very slight and the base of the Pennsylvanian comes to the surface half a mile west of this mine at an altitude about 50 feet higher than that of the clay at this point. It is therefore highly probable that the base of the Pennsylvanian is not much if any below the clay at this place. As elsewhere, the floor here consists of sandstone with ferruginous nodules. Moreover, at the St. Louis Clay Burning Company's plant, half a mile to the southeast, limestone is reported beneath this sandstone, as in the Cheltenham district.

The thickness of the bed at Castello is 12 to 15 feet, 12 feet of good clay being mined. Above the clay lies 55 feet of soft shale, mostly of a red color. Essentially the same section was noted in drilling at the St. Louis Clay Burning Company's plant, half a mile to the southeast. There is also a fire-clay mine at Malcolm station, southeast of Creve Cœur Lake, where the section is the same, including the 18-inch coal bed.

Fire clay has long been known north of Baden, a northern suburb of St. Louis. At the shale quarry of the St. Louis Portland Cement Company the massive shale which is mined is underlain by 2 to 3 feet of black shale and this by 1½ feet of coal, beneath which is the fire clay, said to be 25 feet thick. It is highly probable that the fire clay at this place occupies a sink hole which was formed during the mid-Carboniferous land epoch.

In view of the wide separation of the points at which the Cheltenham fire-clay bed is mined, it is quite probable that it may be found at many places where no prospecting has yet been done.

SHALE.

A characteristic feature of the Pennsylvanian strata near St. Louis is their very large proportion of plastic shale. This is largely used in the manufacture of vitrified paving brick both in St. Louis and to the northwest near Creve Cœur Lake. This shale is the same as that which appears in the sections above the fire clay (see pp. 25–26) but west and north of the city it occurs in thicker and more continuous beds of uniform quality. At Castello and Malcolm stations almost the entire 40 to 55 feet intervening between the loess above and the coal bed overlying the fire clay consists of workable shale, generally of a red or brown color but with some blue shale at its base.

Similar clay 4 miles northwest of Glencoe, a station on the Missouri Pacific Railway some 25 miles west of St. Louis, is largely used in St. Louis in the manufacture of terra cotta and sewer pipe. Shale from this vicinity has also at times been used extensively for brick.

BRICK CLAY.

Many yards in and around St. Louis are making common red brick from the loess, which is commonly called "yellow clay." It is rarely less than 10 or 15 feet thick and near the bluffs may have three or four times that thickness. It differs in texture at different depths, the upper portion being "stronger," more claylike, and less mealy than the main body. (See p. 33.) Partly to obtain a thorough mixture of these different grades and sometimes to allow some weeks or months of "sweating," thus reducing all lumps, large quantities of the loess are commonly brought in from the pits and kept under shed for some time before using. A good grade of red brick is made, and the supply of good loess here and elsewhere is practically limitless.

QUARRY ROCK.

Numerous quarries have been opened in this area, at least 25 being worked at the present time within the city limits of St. Louis. The product of any one quarry is generally varied in character and used for diverse purposes.

SPERGEN LIMESTONE.

The Spergen limestone is quarried at Meramec Highlands (see p. 22) and on Gravois Creek, at the west end of the outcropping strip shown on the geologic map. A 10-foot massive bed at the top yields large blocks well suited for dimension stone. The use of this stone has as yet been small, and its merits other than easy working and good appearance are not known.

ST. LOUIS LIMESTONE.

The quarries in the city of St. Louis are all in the St. Louis limestone. Quarries have been opened in the same formation in the west bluff of the Mississippi south of St. Louis and in the Illinois bluff south of Stolle; also in the bluff of the Missouri north of Creve Cœur Lake. Rock from this formation is also taken out of several quarries on the Meramec, where the chief product comes from the Spergen limestone below.

The St. Louis limestone is at present used principally for road material and foundation stone. A considerable amount is also used for curbing and sewer plates and in the manufacture of whiting. A number of beautiful and durable superstructures have been built of this stone, but it is not in general favor for that purpose. The beds used in this way range in thickness from less than 6 inches to perhaps 1 foot. Many of them are of the very dense and hard variety (see p. 24) and require careful dressing with the hammer. Certain thick beds are said to be well suited to dimension stone, but they are not so used, probably in part because of their dusky color. Chert is so distributed throughout many quarries that their operation for structural materials alone would not be feasible. The use of the remaining material as road metal insures the necessary economy, and the crusher is therefore an adjunct of almost every quarry. The material used for whiting is taken from any bed of pure limestone. The dense beds of lithographic texture are especially valuable for this purpose.

Quarries in the bluffs commonly work a face from 40 to 80 feet high. They can usually be drained without pumping. Quarries not in the bluffs are generally abrupt vertical-sided pits, some of them as deep as 80 feet. The stone is commonly elevated by a hoist, though most quarries still have also an inclined roadway. The water must generally be pumped from such pits, though from a few pits the water has temporarily passed out at the bottom into natural passages leading to the river. Such quarries are not far from the bluffs, and their sites were formerly occupied by sink holes. It is said that such sites have sometimes been chosen with a view to the drainage.

PENNSYLVANIAN SERIES.

Sandstone from the Pennsylvanian has been quarried at various places, but its weakness restricts its use to foundations of small buildings and it can scarcely be said to be an article of trade. Northwest of Clayton a thick bed (probably No. 10 in the section, p. 26) was used in this way before the opening of the quarries in the St. Louis limestone at Vigus. Other openings in similar ledges of uncertain position are all small.

LIME.

Little limestone is used for making lime within the St. Louis quadrangle. West and south of the quadrangle the Kimmswick limestone is largely used for this purpose. In 1890 a study was made [a] of various limestones outcropping in St. Louis County and city, with a view to their larger use in the making of lime. The analyses made in the course of this study show that a considerable portion of the St. Louis limestone contains more than 89 per cent of carbonate of lime, but the industry remains, as it was before, largely confined to the Kimmswick outcrops.

CEMENT MATERIALS.

The cement industry in and near this area is confined to the large plant of the St. Louis Portland Cement Company at Prospect Hill, just north of Baden, a northern suburb of St. Louis. This plant is using the shale of the Pennsylvanian series in connection with the St. Louis limestone, approximately in the proportion of 36 parts of the former to 130 parts of the latter.

The shale is taken from a large quarry in the Mississippi bluff immediately adjacent to the factory. This quarry shows the following section:

Section at shale quarry of St. Louis Portland Cement Company.

	Feet.
7. Soil.	
6. Loess, 5 feet of which at the base grades into a ferruginous residual clay.	
5. Yellowish-gray shale, poorly consolidated	18
4. Blue-gray shale—a firmer rock than No. 5	18
3. Black shale	2–3
2. Coal	1½
1. Fire clay.	

---

[a] Ladd, G. E., The clay, stone, lime, and sand industries of St. Louis city and county: Geol. Survey Missouri, Bull. No. 3, 1890, pp. 73–84.

Nos. 6, 5, and 4 are used, being mixed in the proportions yielded by the quarry. The free silica of the loess, being in very fine grains, is not objectionable in the quantities afforded. In No. 5 the silica may be as high as 60 per cent, but it is in very large part combined and very little grit is noticed in the shale. This is even more true of No. 4, in which the silica does not generally exceed 55 per cent. The highest proportion of iron is found in No. 4 (5 to 5.5 per cent) despite the higher color in No. 5 due to oxidation. No. 4 contains also the largest proportion of alumina (22 to 25 per cent). The lime, magnesia, and alkalies are all low.

The limestone is obtained from quarries 8 miles north of the factory, in the south bluff of the Missouri opposite Bellefontaine. It is the St. Louis limestone and contains a very high percentage of carbonate of lime.

The capacity of the plant is at least 75,000 barrels of cement a month.

SAND AND GRAVEL.

GLASS SAND.

Though glass sand must be obtained beyond the limits of the quadrangle, the manufacture of glass is carried on within the area at two places. Valley Park, Mo., has large plate glass works and Belleville, Ill., has extensive bottle works. Sand is dug from the St. Peter sandstone at Crystal City, where there are also factories, and at Pacific. The latter place supplies sand for the St. Louis Plate Glass Company's large factory at Valley Park.

The merit of the St. Peter as a glass sand consists in part in its friability, by reason of which it is easily excavated and prepared for the factory. Its chief merit, however, is its high degree of purity. Even as obtained in its natural condition the constituents other than pure silica in much of it amount to less than 1 per cent. The most deleterious of these impurities is iron oxide, which appears sparingly in the cement. Its tendency is to discolor the glass. The only other impurity of importance is clay, or the so-called alumina.

The sand is dug from the bank rather than quarried. It is then ground in order to separate all the grains, after which it is washed, the clay being carried away by a stream of water. The sand is then pumped to an appropriate place and dried, after which it is ready for the factory.

At Pacific, the stratum of sandstone suitable for glass making is said to have a total thickness of about 110 feet, being found in hillsides to a height of 60 or 70 feet and underlying the valley to a depth of 40 feet or more. Sand is now taken from the hillsides only. The topographic relations are similar for a number of miles. Probably the purity of the sand will be found to vary from place to place, but the amount available for the future is very large.

BUILDING SAND.

Sand for structural use in St. Louis is practically all pumped from the bed of the Mississippi by a single company, the New Union Sand Company. The sand thus obtained is composed chiefly of fairly sharp quartz grains with an admixture of igneous rock fragments ranging in size up to that of a pea. Occasionally gravel is encountered in "reefs" or long, narrow strips either longitudinal or transverse with reference to the channel. Clay is found here and there in sheets, few of which reach 1 foot in thickness. All the deposits are changeable in composition from place to place, as is to be expected from their origin. At times "live sand" is found—that is, the sand is replaced by the current approximately as fast as it is pumped.

Sand is pumped from a maximum depth of fully 40 feet through 14-inch pipes at a maximum rate exceeding 300 cubic yards an hour. The barges used have a capacity of 400 cubic yards. It is customary to fill 12 or 14 of these barges daily.

MOLDER'S SAND.

Molder's sand is sold in considerable quantities by several firms in St. Louis and the outlying towns. The sand thus used is of diverse geologic origin, but most of it is loess. In the southern part of St. Louis certain alluvial sands occurring in a terrace of River Des Peres have been prospected with a view to use as molder's sand. Though little used up to this time, they will probably be satisfactory.

All pits dug for molder's sand in the loess are in the bluffs of the Mississippi, most of them on the east side, from Peters station, on the north, to French Village. Some of this loess comes from the base of the bluff and underlies minutely laminated sands and silts. There is therefore strong though not conclusive reason for believing that such loess was deposited in water. At other places, as on Schoolhouse Branch, 4 miles south of Peters station, molder's sand is taken from the loess near the crest of the ridge which caps the east bluff. (See p. 33.) At this place it likewise contains large numbers of pulmoniferous shells, so that the strongest arguments for an eolian origin apply to these deposits. From experience thus far, therefore, those qualities of loess which fit it for molding can not be said to be associated with any one origin.

The molder's sand taken from the loess is of the finer grades, some of it, notably that from the crest of the bluff, being best fitted for small castings, brass castings, stove-plate, etc. Much of this bluff deposit is, however, a "general-purpose sand," being used with excellent success for castings as heavy as radiators.

Large quantities of sand sold in St. Louis come from the vicinity of East Alton, Ill. The deposit at this place is described as forming a ridge on the edge of a terrace and is inferred to be made up of eolian loess in a position like that of the loess at Bonfils station, opposite St. Charles (p. 10). The sand from East Alton is of medium grain. It has been used as a general-purpose molding sand for many years.

The sand from the River Des Peres terrace is plainly an alluvial deposit, occurring in a local bed perhaps 5 feet thick. Its grains are angular, though not very diverse in size. It contains some grains of feldspathic and ferromagnesian minerals. There is also a ferruginous pasty coating to the grains which suggests the decomposition of basic igneous grains. This sand, like some others examined, seems to owe its materials to the glacial drift. It has been long enough in its present position to allow partial decomposition of the silicates. A little less perfect assortment and a consequently greater variety of size of grain and a little less rounding by wear would have left a more ideal molder's sand.

In general, the property desired in molder's sand is the ability to pack into a firm mass without loss of porosity or liability to large shrinkage. Without porosity the steam caused by the molten metal can not escape and the mold will rupture. The disadvantage of shrinkage is evident. The packing qualities of a molder's sand must, therefore, not be due to clay. In so far as packing can be brought about by diversity of size and angularity of grain it will not involve shrinkage or want of porosity. Any actual adhesion within the best sands examined is due mainly to iron oxide.

CEMENT GRAVEL.

The so-called cement gravel used for roadways and walks is merely gravel which contains sufficient "binder" to cause packing. If the constituent stones of the gravel are of very diverse size, the porosity is small and the amount of binder required is correspondingly small. This commonly consists of clay or of iron oxide.

The Lafayette gravel is fairly well fitted to use where packing is necessary. Its pebbles are much rounded, a feature which interferes with packing, but there is sufficient diversity in their size and a sufficient abundance of the plastic sandy loam (see p. 30) to cause packing. The plasticity and binding properties of this loam are due to its clay and its abundant oxide of iron. The Lafayette gravel is used to some extent for streets where heavy hauling is not permitted.

OIL AND GAS.[a]

At many places in this area drilling has revealed small quantities of petroleum and natural gas. Most of such occurrences are in the Plattin ("Trenton") limestone, though still smaller quantities are encountered at higher levels, having probably escaped upward from the Plattin limestone.

---

[a] The account here given is based on the field work of 1906. Since that time new wells have been drilled on Vandeventer avenue and the gas is again used. Gas has also been discovered and is being used at a number of places from Carondelet on the south to a point several miles north of Normandy Heights; also at Cahokia, Ill., and on the bank of the Mississippi north of East St. Louis. It is probable that the study of sections of these new wells will disclose small folds not previously known.

AREA IN ST. LOUIS.

The best known of these wells are near the center of St. Louis, on the north end of the pitching anticline described on page 36, and shown in cross section in Plate VI, *B*. At the Welle-Boettler bakery, on the corner of Vandeventer avenue and Forest Park boulevard, three wells entered the Plattin limestone. One of these found little indication of either gas or oil, but tapped a very heavy brine in the Plattin. Another found a similar brine and likewise a quantity of gas, which was used under bake ovens for about six months in 1904. It was equivalent at the start to 7 or 8 bushels of coke daily. The closed pressure is said to have reached 240 pounds per square inch, but the circumstances under which this observation was taken are not known. The pressure gradually weakened, until at the end of one year but little gas continued to escape. This well when pumped yielded about a barrel a day of heavy, black, ill-smelling oil. It is known that both gas and oil come from levels below 565 feet, and probably below 600 feet.

The strata passed are known in part from the following log of a well drilled in November, 1904. This well is one of three, no two of which are more than 200 feet apart.

Log of well on northwest corner of Vandeventer avenue and Forest Park boulevard, St. Louis, Mo.[a]

	Thickness.	Depth.
	Feet.	*Feet.*
Filled ground	20	20
Soft gray clay	20	40
Sand and gravel	20	60
Hard gray limestone, shaly; a little water	20	80
Soft brown limestone	20	100
Hard brown limestone	20	120
Soft gray limestone; water at 140-160 and 185-210 feet	120	240
Soft gray shale	20	260
Hard gray limestone	5	265
Soft gray limestone and shale	15	280
Gray limestone; showing of oil at 280-290 and 305-325 feet	180	460
Very hard gray limestone and chert	10	470
Hard gray limestone	15	485
Soft gray shale	5	490
Hard gray limestone	20	510
Soft dark-red shale; showing of oil	20	530
Hard gray limestone	35	565
Hard gray limestone and shale, caving badly	35	600
Soft black shale; a little oil	20	620
Soft brown limestone, Trenton; a little oil	30	650

The well yields a small amount of gas.

In drilling one of the other two wells (not the productive gas well) samples were carefully kept and labeled to indicate the depth. The description of these agrees in the main with the log given above.

---

[a] Obtained by E. O. Ulrich from the driller, E. D. Meloy, and published in Bull. U. S. Geol. Survey No. 264, 1905, p. 89.

Samples from well at Welle-Boettler bakery, St. Louis, Mo.

	Depth in feet.		Depth in feet.
Fine gravel	55	Gray limestone	545
Brown limestone	70	Brown limestone	560
Gray limestone	90	Gray limestone	580
Same	170	Gray shale	600
Same	220	Dark, nearly black, calcareous shale	610
Same	225	Limestone	624, 640
Same	240	Same. (May be mixed with shale)	662
Same	285	Blue noncalcareous shale	685
Limestone and chert	322	Dark-brown noncalcareous shale	735
Same	380	Gray limestone	805, 850, 900
Same	420	Brownish-gray limestone	934
Same	485		
Limestone with brown shale (Fern Glen)	525		
Brown shale or limestone (Fern Glen)	528		

From the above log and samples it is known that the base of the red shale of the Fern Glen is at 530 feet. This is underlain first by 35 feet of hard gray limestone and then by 35 feet of limestone and shale said to contain small quantities of oil. Still lower is 20 feet of black shale which undoubtedly contained some oil. The correlation of these beds beneath the Fern Glen is uncertain, but there is little reason to doubt that the stratum beneath these, a soft brown limestone between 620 and 662 feet, is Kimmswick limestone.[a]

Less than half a mile south by east from the above-described wells, at Tamm's glue factory, is a well which for a short time yielded a considerable amount of gas. Samples taken during the drilling indicate that this gas came from essentially the same horizon as that at the bakery. The base of the red shale of the Fern Glen is here at a depth of 505 feet. As the surface of the ground is 10 or 15 feet lower than at the Welle-Boettler wells, this indicates a northerly dip of the strata of not more than 10 or 15 feet within that distance. Allowance must be made for liability to error in reporting depths, for the dip as determined by other horizons is considerably greater. The section of Tamm's well below the Fern Glen is as follows:

Partial section of well at Tamm's glue factory, St. Louis, Mo.

	Feet.
Red shale (Fern Glen)	495–505
Gray limestone with gas	505–530
Brown shale	530–540
Soft brown limestone (probably Kimmswick); contains gas	540–575
Buff limestone, probably yielding gas	575–610
Blue shale	610–680
Brown shale	680–710
Gas below brown shale; rock not known	710–

---

[a] E. O. Ulrich (Bull. U. S. Geol. Survey No. 264, 1905, p. 90) provisionally classes the 70 feet of limestone beneath the Fern Glen as Kinderhook and the 20 feet of black shale as the Ohio shale (Devonian).

Drops of oil similar to that found in the Welle-Boettler well were frequently observed. Like several of the wells above mentioned, this well was shot with dynamite.

At the quarry of the Fruin-Bambrick Construction Company, one-third of a mile southeast of Tamm's well, similar pockets of gas were encountered at slightly higher levels and in similar rocks. The section is almost identical with that of the Tamm well.

At various other places in St. Louis "showings" of oil have been observed in deep wells. A well drilled in 1905 at the Union Brewery, Gravois and Michigan avenues, St. Louis, encountered a very small amount of oil, but its depth is variously stated. It will be observed that this location is south by east of those mentioned above, not far from the axis of the anticline. A similar showing is said to have been found in a well drilled fifteen or twenty years ago at the Grone brewery, Twentieth street and Clarke avenue.

MISSISSIPPI FLOOD PLAIN.

On the flood plain of the Mississippi, 2 miles southwest of Peters station, in the northeast corner of the area, a well was drilled for oil on the Kellar farm to a depth of 1,504 feet. Between the depths of 1,260 and 1,504 feet this well traversed Ordovician ("Trenton") limestone which yielded a small amount of good-looking oil, having an olive-green color by reflected light and a brownish-red color by transmitted light. The odor of the oil is agreeable. Its gravity is variously stated between 35° and 41° Baumé.

When the Kellar well had been abandoned for many months, the oil continued to escape at a rate of perhaps 1 or 2 gallons a day. Gas likewise continued to rise, causing a continual bubbling or gurgling. Perhaps 75 barrels of oil have been pumped from the well. It was estimated by the owner that the well might have yielded regularly 10 barrels a day. Strong salt water issues from outside the casing at the rate of several barrels an hour. This is believed to come from the sandstone overlying the St. Louis limestone at a depth of 420 feet.

The formations traversed by this well are shown in the section in Plate VI, *A*. The character of each is shown in the following log:

Log of Kellar oil well, near Peters station, Ill.

	Thickness.	Depth.
	Feet.	*Feet.*
Sand, etc	150	150
Ferruginous sandstone	20	170
Shales and limestone	200	370
Fine white sand	50	420
Limestone	220	640
Blue shale	40	680
Limestone	180	860
Blue shale	60	920
Cherty limestone.	130	1,050
Limestone	110	1,160
Dark shale	100	1,260
Limestone with iron stain; "oil rock"	244	1,504

Drilling is now in progress a short distance north of Peters station, about 4 miles from the Kellar well.

REGION WEST OF ST. LOUIS.

Attempts have been made to find oil at several places west of the area mapped. A well sunk by the Glencoe Lime and Cement Company, 2 miles northwest of Glencoe, entered the Plattin limestone at the surface, striking the St. Peter sandstone at a depth of 110 feet and passing a succession of sandstones and limestones to a total depth of 1,500 feet. Only an occasional "odor of gas and oil" was discovered. Similar results were obtained at Rankin station, 2 miles west of Valley Park, where the corresponding formations were found 300 or 400 feet deeper. Thus far no valid reasons exist for expecting valuable deposits in this area below the Plattin limestone.

PROSPECTS.

Many reports of oil are based on nothing more than a limonitic scum on stagnant water. Others have for their basis an insipid or disagreeable taste of well waters which is in no way related to oil.

So far as oil and gas have yet been found in this region, their occurrence is exactly where it should be expected from a study of the structure, namely, on the crest of a gentle anticline. It is not improbable that there are similar anticlines not now known. Other similar pockets of gas and oil may therefore be found in the future. So long as they remain undiscovered there is no positive evidence that larger ones may exist than those already found. Any search for them should be preceded by a careful exploration of local folds. This is emphasized by the remarkable agreement of the distribution so far as known with the anticlinal theory.

Difficulties in applying this theory to the St. Louis region arise (1) from the loess cover and the fewness of the outcrops; (2) from three unconformities of erosion and, to an unknown extent, of angle. The first of these unconformities is between the Kimmswick limestone, which contains the supposed deposits, and the overlying upper Ordovician shale believed to be of Maquoketa age. The second is between the Ordovician system and the Carboniferous. Discrepancy of angle corresponding to these unconformities has not been shown in this area, and it is probably not great if it exists at all. It is to be remembered, however, that the localization of gas and oil is determined by relatively small folds. The third unconformity is between the Mississippian and the Pennsylvanian series. Although a distinct unconformity of angle at this horizon is not shown within the area considered, it is known to exist at places somewhat nearer the Ozarks, and may yet be found in this area. To judge from the wells whose logs were obtained there is a strong supposition that in the small anticline in St. Louis which has given showings of gas and oil the Kimmswick limestone is essentially parallel to the beds at the surface (St. Louis limestone).

COAL.

ILLINOIS.

The area studied embraces a portion of the western margin of the Eastern Interior coal region. An adequate treatment of the coal beds in the St. Louis quadrangle would therefore require the study of a much broader area.

There is but one bed of commercial importance here, known as the Belleville bed or No. 6 of the Illinois reports, the most extensively mined bed in the State. Its position and that of the smaller beds or blossoms are shown in the sections (pp. 25–28). The thickness of the Belleville bed ranges from 5½ to 7½ feet, with an average of more than 6 feet.[a] It contains a few knife-edge partings of sulphur and at places one or two shale or bone partings about half an inch thick.

The depth of this bed beneath the upland is from 150 to 160 feet at Belleville and about the same at Collinsville. West of the former place and south of the latter the coal approaches the surface, outcropping in the Mississippi bluff as far south as Centerville. Farther south its line of outcrop extends southeastward across the upland.

A number of shafts are clustered around Belleville and Collinsville, but most of these are east of the St. Louis quadrangle. Along the bluff from Caseyville to Centerville coal has been taken from a number of slopes, but these are practically abandoned.

The roof is commonly of shale, having a thickness varying from a few inches to a few feet, and overlain by a strong limestone. The floor is a clay or soft clay shale; it is locally called fire clay, but its utility as such has not been determined.

The properties of this coal may be judged from the analysis of a sample from a mine of the Western Anthracite Coal and Coke Company, known as the St. Louis and O'Fallon No. 1, or Nigger Hollow, mine. It is located 5½ miles west of south from O'Fallon, Ill. The analysis of this coal is as follows:

Analysis of coal from St. Louis and O'Fallon mine No. 1.[b]

Proximate:	
Moisture	9.75
Volatile matter	37.48
Fixed carbon	39.57
Ash	13.20
	100.00

---

[a] This coal was sampled by M. R. Campbell and tested at the coal-testing plant in St. Louis. Most of the data concerning it are found in Bull. U. S. Geol. Survey No. 261 and Prof. Paper No. 48.

[b] Prof. Paper U. S. Geol. Survey No. 48, 1906, p. 206.

Ultimate:	
Hydrogen	5. 31
Carbon	59. 72
Nitrogen	1. 03
Oxygen	16. 64
Sulphur	4. 10
Ash	13. 20
	100. 00
Calorific value:	
Calories	6, 235
British thermal units	11, 223

This is the analysis of a car sample representing 15 tons of coal. As the loss of moisture on air drying was 3.7 per cent, the analysis of the air-dried sample showed all the other figures somewhat larger than here given.

From the above data the fuel ratio is seen to be 1.06. The ultimate analysis shows the carbon-hydrogen ratio to be 12.2. This coal therefore falls in Group I, the lowest group of bituminous coals according to the classification proposed by the authors of the report cited.

The output of the mines in this vicinity is in general use as a steam coal. In the lump condition it does not coke, but on experiment a partial success in coking has been attained with the slack after being washed to reduce the excessive amount of ash. The high percentage of sulphur originally present in gypsum would prevent the use of this coke in blast furnaces or cupolas, but would not interfere with its use for lead or zinc works.

The output of coal in this area is not definitely ascertained, but the two counties represented are among the foremost coal-producing counties of Illinois, St. Clair County in 1908 ranking fourth, with a production of 3,696,017 tons, and Madison County fifth, with 3,367,820 tons.

MISSOURI.

On the Missouri side of the river the same gentle downward folding which has resulted in the preservation of the Cheltenham fire clay from erosion has preserved one or two thin beds of coal. One of these, which is very local in extent and has a maximum thickness, in this part of the field, of perhaps 1½ feet, lies immediately above the fire clay. Another, equally local and having a maximum thickness of 4 feet, lies about 50 feet higher. Both of these were mined in the early history of St. Louis, and although their content was such as would now be considered insignificant, their influence on the early development of the city's industries was great. They are not mined at the present time, except incidentally in the mining of the clay.

WATER RESOURCES.[a]

STREAMS AND LAKES.

Owing to the large city population of this area, a large proportion of the water used for domestic and manufacturing purposes is derived from city water systems which obtain their supply from Mississippi River. As it comes from the river this water is muddy and hard. It is subjected to straining, settling, aeration, chemical treatment with iron sulphate and quicklime, and sometimes to filtering. By these methods it is rendered clear and relatively soft and agreeable to the taste. The waters of the smaller streams and oxbow lakes of the flood plain have been used to a small extent by manufacturing establishments, but those of the lakes at least are muddy and very hard and are not in favor.

SHALLOW WELLS.

The use of water from shallow wells for domestic purposes is common. It is estimated that even in the densely populated parts of St. Louis there were in 1906 between 2,000 and 3,000 surface wells in regular use for domestic purposes. A steady diminution in their use results partly from the excellence of the city water supply and partly from the vigilance of the health department, which is educating the users as rapidly as possible. The number of such wells in use a few years ago was approximately 8,000.

WELLS ON THE MISSISSIPPI FLOOD PLAIN.

Wells on the flood plain are dug, or more commonly driven, to one of the many gravelly beds intercalated in the sand which constitutes the great body of the alluvium below the surface clays. The surface of the ground water on the flood plain varies from a few inches to a few feet beneath the surface, but in the clays near the surface the movement is so slow that wells in it would have small capacity. The same is true in a less degree of the sands. The gravels have no larger proportion of pore space than the sands, but as the openings are larger the water passes through them and into the well at a more rapid rate. The depth of these flood-plain wells varies from 10 to several hundred feet. The deeper wells traverse many water-bearing gravels, thus obtaining a greater capacity. Near the edge of the flood plain, where its surface rises toward the bluff, it is necessary to go much deeper to find the first water-bearing bed than it is near the river.

---

[a] Some of the data concerning water resources have been obtained from the field notes and manuscript of Isaiah Bowman, the results of whose work on the water resources of the East St. Louis district have since been published by the Illinois Geological Survey as Bulletin 5, Water resources of the East St. Louis district, 1907. Many of the points mentioned here are discussed by him in greater detail so far as they relate to the east side of the river.

WELLS ON THE UPLAND.

Many wells on the upland go to the more gravelly basal portion of the loess, obtaining there a moderate supply of good water, though in many of them it has a clayey taste. The depth of such wells east of the Mississippi ranges from 20 to 80 feet, averaging probably about 30 feet. West of the Mississippi the depths are less. On the Illinois side many wells for domestic use enter the glacial drift, the water thus obtained being less liable to contamination than that which comes from the highly porous loess.

In those portions of the upland where sink holes are numerous wells are at a disadvantage in various ways. The water which descends in the sink hole follows an enlarged jointing crack or a true cave, different streams thus formed being at very different levels within short distances. The clogging of some of these passages makes the difference of level in near-by cavities still greater. As the intervening limestone is dense, the getting of well water depends on the striking of such an opening. The resulting uncertainty of depth deters many from attempts to find water in this way.

A second disadvantage in reliance on wells in a sink-hole region is the turbidity of the water after rains. This condition is especially prevalent in this loess-covered region, where rains wash the loess into subterranean passages in the same manner as it is washed into streams, leaving the waters in the former quite as turbid as in the latter.

A third and more serious consideration is the ready washing in of contaminating materials and the traveling of such constituents for long distances without that purification which attends slow percolation. This danger appeals less to most people than the disadvantages above mentioned, but here and there it is more or less consciously realized.

All these considerations adverse to shallow wells in sink-hole districts apply to the city of St. Louis, where sink-holes were formerly numerous. The consideration last mentioned has added force on account of the many sources of contamination in a great city.

CISTERNS.

As a result of the above-stated considerations, the custom of using cistern water for all domestic purposes is very general in the sink-hole regions and to some extent in the other parts of this area. A decided difference in this respect is, however, noticed between the area underlain by limestone and that underlain by the Pennsylvanian shales, the latter having relatively few cisterns.

SPRINGS.

Springs occur in this area in considerable numbers, issuing at various horizons. Small springs and seepages are not uncommon at the contact of the loess and the Pennsylvanian shales. Many issue from passages or incipient caves in the St. Louis limestone. The Osage group contains similar though smaller and less abundant passages.

At Falling Spring, 2 miles south of Stolle, Ill., a large underground passage in the St. Louis limestone emerges halfway up the side of a 150-foot cliff. The discharge, which forms a tributary to Prairie du Pont Creek, is equivalent to the flow from a 12 or 15 inch pipe and is used for steam in locomotives. The source of this water is the very much pitted upland extending for several miles to the east. The numerous sink holes in this area conduct all the water to underground passages and run-off is entirely lacking.

DEEP WELLS.

CARBONIFEROUS SYSTEM.

Many of the deep wells derive their water from the St. Louis limestone. The water is generally of agreeable taste, but is always hard and sometimes salty. The various sands of the Carboniferous likewise yield water. The principal one of these on the Illinois side is the thick stratum (50 to 75 feet) at the base of the Pennsylvanian, provisionally classed as Chester. At Belleville the city water supply is derived from this sandstone, which is there from 500 to 600 feet below the surface. In the northeastern part of the area the water from this stratum, though abundant, is salty. The constant flow of salt water from the Kellar oil well, 2 miles south of Peters station, is thought to be largely from this stratum. Salt water may also be found in the higher sandstones of the Pennsylvanian, as at Mascoutah.[a]

The limestones of the Osage group (Keokuk and Burlington), where near enough to the surface to be subject to weathering, are in many places cavernous and good water bearers; but where deeply buried they are relatively compact and yield less water. The water derived from them is frequently salty, as was noted in drilling the Belcher well, the wells on the Keyes dairy farm near Valley Park, and the wells at the ice factory at Mentor. In the Kellar oil well the limestone is reported as a "salt sand."

The water from the Kinderhook formation, where that is covered by other strata, as east of the Mississippi, is similarly brackish and unfit for domestic use. This formation is frequently encountered in drilling deep wells in St. Louis and its waters are cased off. The water is often spoken of as containing "soluble sulphur," doubtless in allusion to the various sulphates resulting from the oxidation and decomposition of iron pyrite. Some such waters have a peculiarly flat, insipid, or disgusting taste.

---

[a] Bowman, Isaiah, loc. cit.

ORDOVICIAN SYSTEM.

The limestones and shales of the upper Ordovician yield little water in this area where deeply buried. The strong salt water in some of the wells drilled for gas comes from this horizon. South of the area near Kimmswick and Sulphur Springs, Mo., great springs issue at the horizons of the Kimmswick and Plattin limestones. These springs are strongly marked by sulphur and salt and at least one contains magnesia. It is not certain, however, that either the abundance of this water or its character is due to the nature of the rocks from which it issues. They may perhaps be best explained by referring it to the underlying St. Peter sandstone.

The St. Peter sandstone throughout the area studied bears water abundantly. It is almost universally characterized by salt or sulphur, or both. It is the source of water in many artesian wells of St. Louis, among them the Belcher well, which is widely known for its mineral character. The capacity of this well is a little less than 40 gallons a minute. An analysis of this water published by the Belcher Hotel Company is as follows:

Analysis of water from the Belcher well, St. Louis, Mo.

[Parts per million.]

Carbonate of iron	9.4
$CaCO_3$	189.8
$MgCO_3$	18.2
CaCl	496.3
MgCl	684.6
$CaSO_4$	815.6
KCl	160.8
NaCl	6,275.2
SiO_2	2.4
H_2S	14.1
CO_2	55.2
	8,721.6
Total by direct determination	8,791

All wells reaching the St. Peter sandstone have found similar water. The formation increases in depth to the east and is reached at Mascoutah, Ill., 10 miles east of Belleville, at a depth of 3,069 feet. The water in this well, as in those farther west, is unfit for domestic use.

The capacity of deep wells in and near St. Louis, from whatever stratum their supply is derived, rarely exceeds 100 gallons a minute, and 40 gallons is considered a fair yield.

FLOWING WELLS.

The flowing wells of the area range in depth from less than 300 feet to more than 2,500 feet and in geologic horizon from the Osage group to the St. Peter sandstone. Flow from the Osage group is exemplified in a well at Edgemont, Ill., 782 feet deep, and probably also at the

Keyes dairy farm, 2 miles east of Valley Park, Mo. A flowing well at Peters station 1,506 feet deep probably derives its water from Ordovician limestone. The same formation probably also yields a part of the water that issues from the deep well at Monks Mound.

Most of the flowing wells of the area tap the great reservoir of water in the St. Peter sandstone. Flows from this source are obtained by the wells at Monks Mound, Mascoutah, and Granite City, Ill., and the Belcher and other wells in St. Louis. In no well is the head sufficient to cause a very large flow.

INDEX.

A. Page.

- Acknowledgments to those aiding... 7-8
- Algonkian time, events in... 37
- Alton, Ill., coal at... 30
- Ashburner, C. A., information possessed by.. 16
- Atkinson, C. W., well data of... 15-16

B.

- Baden, cement plant at... 55
  - clay near... 53
- Ballwin, gravel near... 30, 31
- Bedford type of limestone, occurrence and character of... 23
- Belcher well, Mo., record of... 17, 18
  - water of... 67, 68, 69
    - analysis of... 68
- Bellefontaine, limestone from... 56
- Belleville, Ill., section at... 27
  - water supply of... 67
  - wells near... 68
- Belleville coal, character of... 29-30, 63-64
- Bowman, Isaiah, on water resources... 65
- Brick clay, occurrence and character of... 53-54
- Broadhead, G. C., work of... 16
- Building sand, occurrence and character of.. 57
- Building stone, occurrence and character of.. 54-55
- Burlington limestone, occurrence and character of... 20-21
  - water of... 67

C.

- Cahokia Mound, description of... 12
- Cambrian time, conditions in... 37
- Cambro-Ordovician time, events in... 37-38
- Cap au Gres sandstone. *See* St. Peter sandstone.
- Carboniferous system, deposition of... 40-43
  - occurrence and character of... 19-30
  - water from... 67-68
- Caseyville, Ill., coal near... 63
- Castello, clay near... 52-53
- Cement gravel, occurrence and character of.. 58
- Cement materials, occurrence and character of... 55-56
- Centerville, Ill., coal near... 63
- Chain of Rocks, drift near... 32
- Cheltenham district, section in... 25
  - section in, coal in... 29
  - topography in... 11
- Cheltenham fire clay, deposition of... 43
  - occurrence and character of... 28, 50-51, 52
- Chester group, deposition of... 42
  - occurrence and character of... 24-25
  - water from... 67
- Cisterns, use of... 66
- Clay, occurrence and character of... 49
  - *See also* Fire clay; Brick; Shale; etc.
- Clayton, Mo., clay near... 52
  - section near... 25
- Coal, analysis of... 63-64
  - deposition of... 42-43
  - occurrence and character of... 29-30, 63-64
  - production of... 64
- Coal measures. *See* Pennsylvanian series.
- "Coal Series," section of... 27
- Collinsville, Ill., coal near... 63
  - section near... 29
- Creve Cœur Lake, fire clay at... 28
- Crystal City, sand at... 56
  - section at, plate showing... 36
- Crystal City sandstone. *See* St. Peter sandstone.

D.

- Des Peres River, loess near... 33
  - sand at... 57, 58
  - valley of, character of... 10
- Devonian time, conditions in... 39
- Drainage, description of... 12-13
- Drushell, J. A., work of... 8, 32

E.

- East Alton, Ill., sand from... 57-58
- Economic geology, description of... 49-69
- Edgemont, flood line near... 12
  - flowing well at... 68
- Edwardsville, Ill., drift near... 33
- Elevations, data on... 9, 11
- Elmwood Park, gravel near... 31
- Eyerman's quarry, rocks of... 24

F.

- Falling Spring, description of... 67
- Fern Glen, Mo., section at... 19
- Fern Glen limestone member, deposition of.. 40
  - occurrence and character of... 20
- Fire clay, mining of... 49-51
  - occurrence and character of... 49-51, 52-53
  - uses of... 51-52
  - *See also* Cheltenham fire clay.
- First sandstone. *See* St. Peter sandstone.
- Flood plain. *See* Mississippi flood plain.
- Floods, height of... 11-12
- Flowing wells, water of... 68-69
- Fowke, Gerard, work of... 8
- French Village, sand from... 57
- Fruin-Bambrick Construction Co., well of, gas in... 61

G Page.

Gas. *See* Oil and gas.
Geologic history.......... 36–49
Geologic map of quadrangle.......... Pocket.
Geology of area, description of.......... 13–35
Geology of region, outline of.......... 8–9
Glaciated area, relations of, to area.......... 9
Glass sand, occurrence and character of.......... 56
Glencoe, view near.......... 30
    well near.......... 62
Glen Park, Mo., section at.......... 19
Granite City, Ill., well at.......... 69
Gravel. *See* Sand and gravel; Cement gravel.
Grover, gravel at.......... 30, 44

H.

Hambach, —, cited.......... 37
    well data from.......... 16
Historical geology.......... 36–49
Hohn, Louis, well data of.......... 17

I.

Illinoian drift, deposition of.......... 46
    occurrence and character of.......... 32–33
Illinois, coal in.......... 63–64
    cooperation of.......... 7
Illinois Hydraulic Press Brick Co., well of, record of.......... 28
Insane Asylum, Mo., well near, section of.. 15–17, 18

J.

Jamieson-French mine, section at.......... 25–26
Jefferson Barracks, drift near.......... 32
Joachim limestone, deposition of.......... 38
    occurrence of.......... 18
Jones, J. C., work of.......... 7

K.

Kansan drift, deposition of.......... 46
    occurrence and character of.......... 31–32
Kellar farm, oil well on.......... 61
    oil well on, section of.......... 61
        water from.......... 67
Keokuk limestone, occurrence and character of.......... 20–21
    water of.......... 67
Keyes farm, wells at.......... 67, 69
Kimmswick limestone, deposition of.......... 38
    occurrence of.......... 18
    water from.......... 68
Kinderhook formation, deposition of.......... 40
    occurrence and character of.......... 19–20
    water from.......... 67–68
Krümmel & Büchner mine, section at.......... 26

L.

Lafayette gravel, deposition of.......... 44–45
    occurrence and character of.......... 30
    use of.......... 58
    view of.......... 30
Lake water, character of.......... 65
Lime, limestone for, occurrence and character of.......... 55
Litton, A., work of.......... 17
Location of area, map showing.......... 8–9

Page.

Loess, deposition of.......... 46–47
    occurrence and character of.......... 30, 31, 33–34
    view of.......... 30

M.

McGee, W J, aid of.......... 7
Magnesian limestones, deposition of.......... 37–38
Malcolm, clay at.......... 53
Map, geologic, of quadrangle.......... Pocket
Map, index, showing area.......... 8
Maquoketa shale, deposition of.......... 39
    occurrence of.......... 18
Mascoutah, well water at.......... 67, 68, 69
Mentor, wells at.......... 67
Meramec group, occurrence and character of. 21–24
Meramec Highlands, Mo., rocks at, view of... 18
    section near.......... 22
Meramec Valley, loess in.......... 33
Mississippi River, flood plain of, description of.......... 11–12
        oil wells in.......... 61–62
        soil of.......... 34
        wells in.......... 65
    sand from.......... 57
Mississippian series, deposition of.......... 40–42
    occurrence and character of.......... 19–25
Mississippi trough, corrasion in.......... 48–49
Missouri, coal of.......... 64
Molder's sand, occurrence and character of... 57–58
Monks Mound, Ill., description of.......... 12
    section at, plate showing.......... 36
    well near, section of.......... 14–15, 18, 25–26
        water of.......... 69
Mounds, occurrence and character of.......... 12

N.

Nigger Hollow mine, coal from.......... 63–64

O.

Oil and gas, occurrence of.......... 58–62
    prospects of.......... 62–63
Ordovician system, deposition of.......... 38–39
    occurrence and character of.......... 18
    water from.......... 68, 69
Osage group, deposition of.......... 40–41
    occurrence and character of.......... 20–21
    water from.......... 67, 68

P.

Pacific, gravel near.......... 30, 31, 44–45
    rocks at, view of.......... 18
    sand at.......... 56
    section at, figures showing.......... 36
Pacific sandstone. *See* St. Peter sandstone.
Pattonville, Mo., section near.......... 26
Peneplain, occurrence of.......... 43–44
Pennsylvanian series, deposition of.......... 42–43
    occurrence and character of.......... 25–30
    sandstones of.......... 28–29
        use of.......... 55
    water from.......... 67
Peters, sand from.......... 57
    section at, plate showing.......... 36
    wells at and near.......... 62, 67

	Page.
Plattin limestone, brine in	59
deposition of	38
occurrence of	18
oil and gas in	58
water from	68
Pleistocene deposits, deposition in	46–47
occurrence and character of	31–34
Post-Carboniferous time, events in	43–44
Postglacial erosion, history of	48–49
Post-Pliocene time, events in	45
Pre-Quaternary time, events in	45–46

Q.

Quarry rock, occurrence and character of	54–55
Quaternary system, occurrence and character of	31–34

R.

Rankin, well at	62
Recent deposits, occurrence and character of	34–35
Rock terraces, location and character of	10

S.

Saccharoidal sandstone. *See* St. Peter sandstone.	
St. Louis, gravel near	44
loess near	46–47
St. Louis and O'Fallon mine, coal from	63–64
St. Louis limestone, deposition of	41–42
occurrence and character of	23–24
views of	24, 30
use of, for building	54–55
water from	67
St. Louis Portland Cement Co., quarry of, section in	55
St. Peter sandstone, deposition of	38
occurrence and character of	18
sand from	56
view of	18
water from	68, 69
Salisbury, R. D., aid of	7
Sand and gravel, occurrence and character of	56–58
Sandstones, Pennsylvanian, occurrence and character of	28–29
use of	55
water from	67
Schoenberger Creek, course of	13
Schoolhouse Branch, sand from	57
Section, general, rocks in	13–14
Sections, structure, plate showing	36
Sections, well, details of	14–17
Shale, occurrence and character of	53
Shellenberger, well data of	15
Silurian-Devonian time, conditions during	39
Sink holes, occurrence of	10–11
view of	10
Spergen limestone, deposition of	40, 41
occurrence and character of	22–23
use of, for building	54
view of	18
Springs, occurrence and character of	67
Stolle, Ill., loess near, view of	30
sinkholes near, view of	10
Stratigraphy, description of	13–35
Stream water, character of	65
Structure, character of	35–36
relation of, to topography	10
sections showing, plate showing	36
Swallow, G. C., on coal measures	26–27, 29

T.

Tamm's glue factory, well at, log of	60–61
Terraces, alluvial, occurrence and character of	34–35
See also Rock terraces.	
Tertiary system, occurrence and character of	30–31
Todd, J. E., cited	32
Topography, description of	9–13
relation of, to structure	10–11

U.

Ulrich, E. O., work of	15
Union Brewery, well at, oil in	61
Upland, description of	9–11
wells on	66

V.

Valley Park, wells near	67, 69
Valleys, small, location and character of	10

W.

Warsaw shale, deposition of	41
occurrence and character of	21–22
Water resources, description of	65–69
Watkins Creek, drift near	32
Webster Grove, gravel at	31
Welle-Boettler bakery, wells at, logs of	59–60
Weller, Stuart, aid of	7
Wells, deep, water of, analysis of	68
source of	67–69
Wells, flowing, distribution and character of	68–69
Wells, shallow, use of	65
water of	65–66
Wheeler, H. A., cited	32
Wisconsin time, events in	47
Worthen, A. H., cited	32
Wright, G. F., cited	32

O